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THE

PHILOSOPHICAL TRANSACTIONS

(From the Year 1732, to the Year 1744)

ABRIDGED,

AND

Diſpoſed under GENERAL HEADS,

The *Latin* PAPERS being tranſlated into *Engliſh.*

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VOL. VIII. PART II.

CONTAINING THE

PHYSIOLOGICAL PAPERS.

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LONDON:

PHILOSOPHICAL PAPERS

FROM VOL. LIII. PART II.

BY JOHN MAYNARD KEYNES

Fellow of King's College, Cambridge.

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AND

ABRIDGED

(From the Jour. for the Soc. 1744)

TRANSACTIONS

OF THE

PHILOSOPHICAL

THE

Philosophical Transactions

ABRIDGED.

PART II.

CONTAINING THE

PHYSIOLOGICAL PAPERS.

CHAP. I.

PHYSIOLOGY, METEOROLOGY, PNEUMATICKS.

I. IT may, perhaps, be needless now to add any thing in Confirmation of Dr *Wallis*'s Solution of the *Sun* and *Moon*'s appearing so much larger at rising or setting, than when in a greater Altitude; tho' some have very absurdly still gone on to account for it from Vapours, which I remember was given me in my Youth for the true Cause of it. 'Tis true, indeed, that 'tis these Vapours, or the Atmosphere, alone, that make those Bodies, when very near to the *Horizon*, appear in a spheroidal Form, by refracting, and thereby raising (to Sight), the lower Limb more than the upper, yet these can be no Cause of the other. The *Sun* and *Moon*, each subtending about half a Degree, appear in the Meridian

Some Thoughts concerning the Sun *and* Moon, *when near the* Horizon, *appearing larger than when near the* Zenith; *by* James Logan, No. 444. p. 404. *dated* Philadelphia, Sept. 20 1735.

of the Breadth of 8 or 10 Inches, to ſome Eyes more, and to others leſs; and in the *Horizon* to be 2 or 3 Foot, more or leſs, according to the Extent of Ground they are ſeen over: But if one can have an Opportunity, as I have here frequently had, of ſeeing the *Sun* riſe or ſet over a ſmall Eminence at the Diſtance of a Mile or two with tall Trees on it ſtanding pretty cloſe, as is uſual in Woods without Underwood, his Body will then appear to be 10 or 12 Foot in Breadth, according to the Diſtance and Circumſtances of the Trees he is ſeen through; and where there has been ſome thin Underwood, or a few Saplings, I have obſerved that the *Sun* ſetting red, has appeared through them like a large extenſive Flame, as if ſome Houſe were on Fire beyond them. Now the Reaſon of this is obvious, *viz.* that being well acquainted with Trees, the Ideas of the Space they take up are in a Manner fixed, and as one of thoſe Trees ſubtends an Angle at the Eye, perhaps not exceeding 3 or 4 Seconds, and would ſcarce be diſtinguiſhable, were it not for the ſtrong Light behind them, the *Sun*'s Diameter of above 30′ takes in ſeveral of them, and therefore will naturally be judged vaſtly larger. Hence 'tis evident, that thoſe Bodies appear greater or leſs, according to the Objects interpoſed or taken in by the Eye on viewing them. And to this only is that Phænomenon to be imputed.

I am ſenſible this Method of arguing is not new, yet the Obſervations here given may probably tend to illuſtrate the Caſe beyond what had been advanced on the Subject.

A Phyſico-mathematical Demonſtration of the Impoſſibility and Inſufficiency of Vortices: *By M.* de Sigorgne. *Tranſlated from the* French *by* T.S. *M.D. F.R.S.* No. 457. p. 409. July *&c.* 1740.

II. That natural Philoſophers of an inferior Claſs, who conſider only the Outſide of Things, are obſtinate in the Defence of *Vortices*, is, in my Opinion, not to be wondered at: The Idea of them ſtrikes the Mind very agreeably at firſt, and even ſeems to promiſe the true Mechaniſm. But that Perſons verſed in the moſt profound Geometry, and in the moſt ſublime Calculations, able Academicians, who inceſſantly apply themſelves to the Study of Nature, ſhould plunge headlong into theſe Notions, and ſuſtain the *Vortices pro aris & focis*, is to me Matter of unaccountable Surprize.

It has been long ſince ſaid, that according as *Vortices* ſhall be multiplied, they will degenerate into Littleneſs and Puerility: And theſe are the Sentiments even of the good *Carteſians* of our Days. But might it not be ſaid, that the great *Vortices* having the ſame Origin with the little, the latter ſhew the Meanneſs of Extraction of the former? As Matter is diviſible *in infinitum*; as to Vorticity, there is no Difference between the Great and the Small: And conſequently, we have a Right to reject the large *Vortices*, ſince *Carteſians* proſcribe the ſmall.

It is on this Conſideration that I am reſolved to attack the *Vortices*: For I muſt own, to the Shame of our Nation, that the Spirit of Party is ſo predominant therein, that ſeveral Perſons, who by a cloſe Study have found the Inſufficiency of *Vortices*, for explaining the *Phænomena* of the Heavens, yet have not dared to publiſh their Notions on that Subject.

But as at preſent the Syſtem of ſmall *Vortices* is freely attacked, I think, that I have a Right to attack the large; and to this Purpoſe I hope to prove,

I. That the mechanical Formation of a *Vortex* is impoſſible.
II. That the *Vortex*, were it formed, cannot be of long Duration.
III. In fine, that it is not ſufficient for explaining the *Phænomena*.

The mechanical Generation of the Vortex *is impoſſible.* PART. I.

Demonſtration. In the Hypotheſis of a perfect *Plenum*, GOD at firſt created Matter indefinite, uniform, homogeneous, and at Reſt. This is allowed by all *Carteſians*, and follows in their Principles from this alone, that Matter was created at Reſt. Now, from this perfect Homogeneity of Matter it evidently reſults, in my Opinion, that the *Vortex* cannot be mechanically formed. Suppoſe, ſay the *Carteſians*, that while Matter is as yet at Reſt, GOD imprints a Motion in a ſtrait Line on one of it's Particles: This Particle will every Inſtant meet with Obſtacles to the rectilinear Motion in the encompaſſing Matter; this Motion muſt therefore be turned aſide, and will by this means become circular.

But why ſhould the encompaſſing Matter, which is at Reſt, be an Obſtacle to the rectilinear Motion? Becauſe, ſay they, it happens to be in the Line deſcribed by the Particle, on which Motion is ſuppoſed to be imprinted. But this very Reaſon would alſo prove, that the Body ſuppoſed to be in Motion could not circulate round a Centre at a Diſtance from it; becauſe it would conſtantly meet with Matter at Reſt in the Sides of the Polygon which it was to have deſcribed.

In a Word, it is a received Principle, that a Body which moves in a homogeneous Medium, never quits the Line of it's firſt Direction: It does not refract, or deviate on one Side or the other of this Direction, except when it paſſes from an eaſier into a more difficult Medium, or from a denſer into a leſs denſe Medium: And even then it's Direction muſt be oblique on the Surface of this Medium.

Now, the Body in Queſtion would move in a Medium entirely homogeneous; ſeeing all the created Matter is ſuppoſed to be ſo, and that all but one Particle of this Matter is at Reſt. It is moreover evident, that as all the Matter is uniform, every Direction, of what kind ſoever, of a Body which moves in the midſt of this Matter, will be perpendicular to the Surface which correſponds to it; as is demonſtrated in Mechanics. The ſuppoſed *Mobile* will therefore always move in the Line of it's firſt Direction, until it has communicated all it's Force; or rather it will remain at Reſt after the leaſt Shock, if Regard be had to nothing more than what I have hitherto ſaid.

But there ſtill remains a very important Remark to be made on this Subject, to wit, that as it is univerſally agreed at this Day, that Reſt is not a Force, all this Matter created at Reſt will be infinitely ſoft: It's

Parts will have no Tenacity, no Connexion, no Viſcoſity; they will be but contiguous, and will not have more Adheſion to one another, than Two Globes which would touch out of the Bounds of the World without any reciprocal Attraction; ſince Tenacity, Viſcoſity, *&c.* are, in the *Carteſian* Syſtem, but the Effects of Compreſſion every Way. Wherefore theſe Parts will be divided at the leaſt Shock, in the ſame manner as if Quickſilver be thrown againſt a Wall, it is inſtantly ſeen to be divided into a Million of Parts, to be reflected on every Side, and be again divided as ſoon as it falls on the Floor. I know my Compariſon is not exact, but the Advantage is on my Side; becauſe Quickſilver is not without Viſcoſity, or a certain Tenacity between it's Parts; whether it proceeds from Attraction, which is my Opinion, or that it be the Effect of the Preſſure of the ambient Fluid. Therefore the *Carteſian* Matter will have more Facility to divide than Quickſilver, and will not be ſuſceptible of any regular Motion; which alone demonſtrates, that the mechanical Generation of the *Vortex* is impoſſible.

There is however this Difference between the *Vortex* imagined by *Deſcartes*, compoſed of hard Globules; and that of the infinitely ſoft Matter of F. *Malebranche*, whoſe Syſtem is revived by his Diſciple M. *de Molieres*; that if the *Carteſians* admitted Gravity as a Principle; beſides that it would give the true Cauſe of Hardneſs, it's Combination with the ſtrait or projectile Motion would produce a Motion in a Curve; as Sir *I. Newton* has demonſtrated. But until they will return to this Idea of primitive Gravity, and further while they will make uſe of no other Matter than one infinitely ſoft, and really unintelligible, it will not be poſſible to conceive a ſingle *Vortex* formed; far from having this infinite Number, which, by-the-bye, ought to be diſſipated as Waves raiſed in the Water, upon account of their perfect Homogeneity.

The famous *Carteſians*, always refuſing to allow this primitive Gravity, and at the ſame Time plainly ſeeing, that this firſt Manner of forming the *Vortex* was impoſſible, have had recourſe, in order to it's Formation, to the Motion of Rotation of a ſolid Sphere at the Centre of a ſmall Particle of Matter at Reſt, *&c.* and they have pretended, that this Sphere in it's Circulation ought to carry along with it the circumambient Matter.

But this Notion is certainly as unſuſtainable as the Firſt. For,

1*ſt*, They muſt explain to us the mechanical Formation of this Sphere; they muſt account for it's Solidity: But all this manifeſtly ſuppoſes the *Vortex* already formed; all this ſuppoſes a Preſſure equal on every Side, uniform and concentric.

2*dly*, This Sphere would never imprint an equal Velocity on all the Points of the concave Surface which touches and incloſes it, ſeeing itſelf has not an equal Velocity in every Point of it's laſt Surface; and therefore the *Vortex* would not have as much Force to defend itſelf towards the Poles, as towards the Equator; as we ſhall ſhew hereafter.

3*dly*,

3*dly*, This Sphere, in ſtriking againſt the ambient Matter, would but divide it *ad infinitum*; becauſe it is infinitely ſoft, and that it's Parts have no Adherence with each other.

4*thly*, It is not ſufficient, that a Sphere turns round it's Centre, to draw into it's Circulation the ambient Matter: It is moreover requiſite, that to preſs on this Matter in a Direction from the Centre to the Circumference, (which a ſolid Globe either cannot do, or can hardly be conceived poſſible for it to do) and further ſtill, it is neceſſary there ſhould be Unevenneſſes on this Sphere, and on the concave Surface of the ambient Matter; becauſe otherwiſe, though the Sphere ſhould preſs this Surface by it's centrifugal Force, it would only raiſe it up, or tend to raiſe it, and it would ſlide along the Surface without dragging it away with it: On which Head there is this Particularity to be remarked, that, for the uniform Circulation and Conſervation of the *Vortex*, and ſtill more for the preſerving of *Kepler*'s Laws, the Spheres and Surfaces muſt be ſtrictly Mathematical, as we ſhall ſoon ſee; and for it's Formation they muſt be rough, and full of Unevenneſſes: But what can be more whimſical? And further, though theſe Surfaces were full of Prickles, yet could not the *Vortex* be formed in the Hypotheſis of F. *Malebranche*'s ſoft Matter; becauſe the Parts which would form theſe Eminences and Unevenneſſes on the concave Surface of the Matter ſurrounding the Sphere, not being connected with the other Parts of the ſame Matter, would be carried off without Difficulty by the Rotation of the Sphere; and the reſt of the Matter would remain at Reſt. And thoſe who would pretend, that theſe Unevenneſſes, theſe Parts which form the Hillocks we are ſpeaking of, could not, in conſequence of God's Decree, looſe themſelves from the other Parts of the Matter, would evidently abandon Mechaniſm, without reaping any Advantage: Becauſe, ſuppoſing it true, that by this Means the ambient Matter would be compelled to circulate, yet could it not form a fluid *Vortex*, wherein *Kepler*'s Laws could be obſerved; becauſe both the Sphere and theſe Surfaces being by theſe Unevenneſſes wedged into each other by ſolid hard and inflexible Parts, they would neceſſarily move all of a Piece, as the Parts of a Sphere do.

5*thly*, By means of this Sphere one could have but a great *Vortex* formed; and not that infinite Multitude of ſmall *Vortices*, with which the great ones are at this Day ſuppoſed to be filled, and in the Centre of all, or moſt Part of which, People will not allow that there are hard Globules, and ſo of the reſt: For I am perſuaded, that the Reader, by a little Meditation on this Subject, will find almoſt as many Reaſons againſt this Syſtem, as there are ſmall *Vortices* ſuppoſed to exiſt.

It may be objected, that we do not pretend to form a *Vortex*: We ſuppoſe that God formed it in the Beginning, and in Conſequence hereof we account for it's properties and Conſervation.

But, beſides that the Impoſſibility of the mechanical Generation of a *Vortex* is a ſtrong Prejudice againſt it's Conſervation; I pretend, in the Principles of our Adverſaries, God could not form a ſingle *Vortex*.

I deſire

I deſire Attention may be given, that a circular Motion is a redoubled and forced Motion; and not, as Mr *Perault* thought, a natural Motion. Now the rectilinear Motion cannot be redoubled thus, as againſt it's Nature, in order to become circular, but upon a Suppoſition that it meets in the ambient Matter invincible Obſtacles to it's Direction; or that by a primitive Law it is carried towards a Centre by a Motion of Gravitation, at the ſame Time that it receives a Motion in a ſtrait Line. Therefore, ſince on one hand this univerſal and primordial Gravity is obſtinately rejected; and on the other, as it is ſolidly proved above, that the ambient Matter is no Obſtacle to the rectilinear Motion; it remains certain, that the Formation of the *Vortex* is impoſſible. *Q. E. D.*

PART II *and* III. *The* Vortex, *though once formed, cannot laſt, and it is not ſufficient for explaining the celeſtial* Phænomena.

Poſtulatum. The cylindric *Vortex* cannot long ſubſiſt, and is not ſufficient for explaining the celeſtial *Phænomena*: This Principle is allowed by all *Carteſians* in both it's Parts. It cannot ſubſiſt; becauſe not having Force to defend itſelf towards the Poles, if it happened to hit on that Side againſt another cylindric *Vortex*, that preſented it's Equator, it would ſoon be broke into, and burſt to it's very Centre. If, on the contrary, it's ſame Side touched another cylindric *Vortex* by the Poles, they would both mix together, and would compoſe but one *Vortex*.

It is not ſufficient for explaining the celeſtial *Phænomena*; becauſe it is allowed, that the tranſlative Velocities of it's Points cannot be in an inverted *Ratio* to the Roots of the Diſtances, and that it's centrifugal Force does not diminiſh in the inverted *Ratio* of the Squares of theſe Diſtances, *&c.*

Corollary. Therefore the ſpherical *Vortex*, in order to be of Uſe, muſt have other Properties than the cylindric: That is to ſay, it muſt have a relative Force to one and the ſame Centre; for it is by this Force alone that it can be different from the cylindric *Vortex*.

This Force, moreover, muſt be equal in all the Points of the ſame ſpherical Superficies; becauſe otherwiſe it might be burſt and broke into in it's weak Parts, as well as the cylindric, *&c.*

Theorem I. Even in the ſpherical *Vortex* there is no relative Force to one and the ſame Centre: That is to ſay, that it has properly but an axifugal Force.

Demonſtration. The ſpherical *Vortex* is compoſed, as well as the cylindrical, of ſeveral parallel Circles, but with this Difference, that in the ſpherical *Vortex* the *Radii* of the parallel Circles are not all equal, but on the contrary diminiſh according as they recede from the Equator, and approach the Poles. Now it is manifeſt, that all the parallel Circles circulating round different Points of the Axis in the ſpherical *Vortex*, as well as in the cylindrical, tend to recede only from theſe different Points of the Axis, round which they circulate; becauſe a Body cannot tend to recede from any Centre but

but that of it's Circulation. In a Word, in order to make a *Vortex* ſpherical, which was cylindrical, they have but proportionally ſhortened the parallel Circles. But let the *Radius* of a Circle be ever ſo much ſhortened or lengthened, that will not change the Direction of it's dilative Effort. I am miſtaken! An imaginary Line is going to change the Direction of the axifugal Force. This Force, as all agree, has for it's Direction the *Radius* I C, in the Circumference whereof it is the *Radius*; but the Direction I C is oblique to C E the Tangent to the Sphere; therefore it changes, according to the general Law of an oblique Shock, into the Determination I E or O C relative to the Centre O.

But if Lines may be imagined, and that nothing more is requiſite to realize them, than Points that correſpond to them; we ſhall have ſome of all ſorts in the *Vortex*: We ſhall have oblique Lines on the *Radius* O A, a perpendiclar one, and ſome more or leſs oblique, on the *Radius* I C, and by that means we ſhall be able to determine nothing. Let us grant however, that there is a Tangent to the Sphere C E, at the Point C, and let us ſee if it will be a ſufficient Reaſon for decompoſing the centrifugal Force I C into a central Force I E or O C. For that Purpoſe I aſk, What are the Points that compoſe this Tangent? It is evident that it can only be the Globules of the upper *Stratum* that anſwer thereto. The Line C E is therefore compoſed only of a certain Number of Points ſeparate one from the other, and which conſequently can move one without the other. Therefore if the Line I C is perpendicular to the Globule that occupies the Point C, and that it paſſes through it's Centre; there will be no Decompoſure, and the Force I C will not change into a Force that has the *Radius* O C for it's Direction. Fig. 1.

Now it is infinitely probable, that the *Radius* I C paſſes through the Centre of the Globule C; and it is eaſy to demonſtrate, that it is actually ſo even in the Principles of M. *Saurin*, who firſt invented this central Decompoſition. For what has been the cauſe of the Decompoſition of the circular Velocity into the centrifugal Force I C? It ſeems plain to me, that no other Cauſe can be aſſigned than the Point or Globule C; ſeeing there is but that one at the Point where it happened. The Line I C paſſes then through the Centre of the Globule C; ſince the Decompoſition is always made in a perpendicular Line to the Point that cauſed it.

And indeed, either the *Radius* I C paſſes through the Centre of the Globule C, or the Centre of this Globule is on one Side or the other of this *Radius*, but ſo as that this *Radius* cuts the Point C; or elſe, it is a Space intercepted between two Globules, which directly anſwers to the Point C. In the Firſt Caſe, there is no Decompoſition: In the Second, and in the Hypotheſis, that the Centre of the Globule C happens to be between the *Radius* I C and the Equator, there will be a Decompoſition; but it is manifeſt, that it will not be a central one: It will, on the contrary, be relative either to the very Pole, or to one of the polar Circles. In the Third Caſe, wherein it is ſuppoſed that it is a Space intercepted between

between two Globules, which anſwers to the Point C; there may be a Decompoſition, but it will be double, the one relative to the Centre O, and the other relative to the Pole Z,

Now the *Carteſians* can never draw from this Decompoſition the Advantage they propoſe; becauſe there will not be more Reaſon for heavy Bodies precipitating to the Centre of the Sphere by means of the central Force, than to the very Pole by the Aſſiſtance of the poliſugal Force; or rather, the Complication of theſe two Forces will compel the *Mobile* to precipitate to the Centre I of the Parallel it happens to be in.

Wherefore, in order to defend the ſpherical *Vortex*, they muſt ſay, that the Centre of the Globule C is comprehended between the Poles and the *Radius* I C. But on what Foundation will they aſſure it? What are the Proofs they will give for it? One muſt certainly be a very bold Gameſter, to hazard this Point; becauſe beſides the Appearance of Truth, the Adverſaries of *Vortexes* may wager Three to One, that it does not ſo happen. But in caſe it be allowed, will they ever find in the ſoft Matter of F. *Malebranche* and M. *de Moliere*, a ſufficient Cauſe of the Decompoſition? There muſt be a Reſiſtance to produce a Decompoſition, and an infinitely ſoft Matter does not reſiſt. And further, in the Hypotheſis of the Decompoſition of I C or O C, the *Vortex* would not be in Safety; becauſe there would be a Remainder of the centrifugal Force I C, that would be parallel to the Tangent C E, and would evidently ſpread Confuſion in the *Vortex*, by driving all the parallel Circles towards the Equator.

This ſeems to me ſufficient to diſcredit, in the Minds of rational People free from Prejudice, this central Force, which is attempted by all means to be introduced. But let us not be tired of examining this Point thoroughly: It is of Conſequence, and the *Carteſians* well deſerve the Trouble of an abundant Refutation. Wherefore let us ſuppoſe, that God forms a *Vortex* cylindrical and fluid; it is a received and evident Principle, that it's Points will have but an axifugal Force. And if a Sphere be conceived to be inſcribed in this Cylinder, the Points that compoſe it, will not in like manner have any central centrifugal Force, according to the Axiom: *Noſtrum intelligere nihil ponit in re.* Now let us realize this ſpherical *Vortex*, which before we had but cenceived; that is, let us ſuppoſe, that God has deſtroyed the tranſlative Velocity of the Points that form the angular Spaces intercepted between the laſt Surface of the inſcribed Sphere and that of the Cylinder; it is manifeſt, that no Change will happen in the Velocity and axifugal Force of the reſt of the Points, which are not included in theſe; for this Reaſon, that the Points which fill the two kinds of Baſons that mark the Exceſs of the Cylinder above the inſcribed Sphere, remain in the ſame Order, Diſpoſition, and Direction, with regard to the inferior Points, which they were in at the Time of their Motion. And there is no other Difference to be perceived herein, except that at preſent it is the ſame Point that conſtantly correſponds to the ſame Place; and that before this Place was ſucceſſively occupied by

Points

Points entirely reſembling each other, and that which remains or is ſuppoſed conſtantly to remain therein.

Now whether this Place be conſtantly occupied by one and the ſame Point, or ſucceſſively by Points entirely alike and in the ſame Order, is what ought not to produce any Variation in the Effect which we are examining: And this appears to me at leaſt as clear as Noon-day.

Wherefore, ſince theſe inferior Points had then but an axifugal Force, it follows that even now they have no other Tendency than to recede from the Centres of their Circulations, without having any Force relative to the Centre of the *Vortex*.

This is all that pure Reaſon dictates to me on this Point of the Nature of the *Vortex*, whether ſpherical or cylindrical: And I dare flatter myſelf, that whoſoever will attentively examine my Reaſonings, will find them as demonſtrative as can be deſired in Natural Philoſophy.

In Effect, Experience agrees here with Reaſon. If a glaſs Globe filled with Water be rapidly turned on it's Axis, one ſees little Foulneſſes; the ſmall Atoms which it never fails to contain, gather together along the Axis, and form a little Cylinder round it. ——Which very plainly ſhews, that in this ſpherical *Vortex* of Water there is but an axifugal Force. Q. E. D.

Therefore Gravity is inexplicable in the *Vortex*, and it has not Strength to defend itſelf towards the Poles. Corollary.

Suppoſing there was in the ſpherical *Vortex* a central Force according to the *Radius* O C, it could not by Reaction be changed into a centripetal Force according to the Radius C O. Theorem II. Fig. 1.

This Propoſition is well known to all who are ſomewhat converſant in Mechanics.

It is therein demonſtrated, that if the *Radius* I C, for Example, forms with the Tangent C E an Angle of 45 Degrees, the Line of Reflexion will be parallel to the Axis; and that from the Point C to the Pole Z, the Lines of Reflexion will be divergent to the Axis; and, in fine, that from the Point C to the Equator, theſe ſame Lines of Reflexion will be indeed convergent to the Axis, but will never terminate at the Centre O: In a word, that becauſe the Angle of Reflexion is always equal to the Angle of Incidence, it is only at the Equator that the centrifugal Force can be changed into a centripetal Force. Q. E. D.

Therefore the modern *Carteſians* are ſtrangely miſtaken, when they pretend to account for Gravity by the Reverſe of the central centrifugal Force. Corollary I.

And they can never, *à fortiori*, in their Principles, explain the Figure of the Earth and of *Jupiter*, which are flatted Spheroids made by the Converſion of an Ellipſis upon it's ſmall Axis. Corollary II.

If the centrifugal Force repreſented by I C, be decompoſed on the ſpherical Tangent into a Force, that for it's Direction has the Centre of the Sphere; the central Force, which reſults from this Decompoſition, will be to the centrifugal Force, as the *Radius* I C to the *Radius* O C. Lemma I.

For the centrifugal Force I C, being decompoſed into C on the Tangent of the Sphere, will ſtrike this Tangent with a Force that will be repreſented by I E. But on account of the ſimilar Triangles I E C, I O C: I E. I C: : I C. O C.

Lemma II. A Body which deſcribes a Curve, ſtrikes this Curve every time it paſſes from one Side to the other, with an infinitely ſmall Force of the firſt kind with regard to it's Velocity.

To the beſt of my Remembrance, this Propoſition is demonſtrated in Dr *Clark*'s Notes on *Rohault*'s *Phyſica*, and in M. *de Moliere*'s Lectures: And it is evident from this alone, that it can only be by a Force repreſented by the Sine of the Angle of Contact that this moveable Body ſtrikes the Tangent of it's Curve.

Theorem III. Let us put Complaiſance on the Stretch, and grant that *Vortices* have a central and centripetal Force relative to one Centre O: I ſay, that the ſpherical *Vortex* will not have as much of this central Force, to defend itſelf towards the Poles, as towards the Equator.

Conſtruction. Let us take, in the ſame Superficies X two Points at Pleaſure, the Fig. 1. Point A in the Circumference of the Equator, and the Point C in the Circumference of a ſubduple parallel Circle; we will give in the Demonſtration an equal Velocity to the Globules which circulate in theſe two Circumferences; which is the moſt favourable Conceſſion imaginable for the Patrons of *Vortexes*.

Demonſtration. It is manifeſt, that if the Point A is in an equal Space of Time ſtruck an equal Number of Times as the Point C, and that each Stroke againſt the Point A be double each Stroke againſt the Point C; it is manifeſt, I ſay, that there is more Force at the Equator than at the parallel Circle. Now the Suppoſition is very certain in both it's Parts: For,

1. Since the Circumference of the Equator is the double of that of the parallel Circle, and that being at an equal Diſtance from the Centre O, the Globules they contain are equal to each other; if there be a thouſand Globules in the Circumference of the Parallel, there will be 2000 in the Circumference of the Equator. And as theſe Gobules are ſuppoſed to have in both an equal Velocity, they will make (but) One Revolution in the Equator, while thoſe of the ſubduple Circumference will make two. Therefore, in both, there will be 2000 Strokes employed in the ſame Space of Time, againſt the Points A and C.

2. Each central Stroke is double at the Equator: Becauſe, as there is in both an equal Velocity, and that (Lem. II.) each centrifugal Stroke in every Circumference is a Fluxion of the firſt kind, with regard to the Velocity of the Globule which is in Motion; it follows that the centrifugal Strokes both in the Equator, and in the parallel Circle, are equal to each other. But the central Effort (which is the only one by which a *Vortex* can defend itſelf towards the Poles) is at the Point C (Lem. I.) but half the centrifugal Effort, ſince it is repreſented by I E ſubduple of I C; whereas at the Equator the central Effort is the ſame with the centrifugal

Effort, becauſe the *Radius* O A is perpendicular on the ſpirical Tangent, which correſponds to it. Therefore, *&c.* Q. E. D.

Therefore if a *Vortex* be in *Æquilibrium* with another *Vortex*, and that the Equator of one happens to anſwer to the Poles or Tropics of the other; the latter will be burſt and penetrated to the Centre: And I do not think, that the *Carteſians* can find their Account in this Conſequence. Corollary I.

Therefore if the *Vortex* was the mechanical Cauſe of Gravity, Gravity ought to be greater at the Equator than at the Poles; and the Earth would be an oblong Spheroid; which is contrary to Obſervations. Corollary II.

I have ſaid, that it was making a large Conceſſion to the *Carteſians*, to ſuppoſe that the Globules of both the Circumferences have an equal Velocity. For if a Sphere full of Water be made to turn on it's Centre, Experience teaches, that the Velocity is greater at the Equator than in the parallel Circles; ſince it is obſerved, that the Times of their periodical Revolutions are equal. Whence it follows, that I have, in my Demonſtration, made the moſt favourable Suppoſition for the *Carteſians* that was poſſible, Remark.

In order to determine the Tendency of a Layer towards the Upper Part of the *Vortex*, regard muſt be had not only to that which reſults from it's own Circulation, but alſo to that which it receives from the other lower Layers, unleſs it be the Layer next the Centre. Theorem IV.

While a Layer is in Circulation, it viſibly makes a continual Effort towards dilating itſelf, by reaſon of the centrifugal Force, with which all it's Parts endeavour to recede from the Centre of Circulation: But it's actual Dilatation being impeded by the Layer next above it, this laſt will be naturally preſſed by it. And thus it is that the firſt or loweſt Layer, being put into Circulation, preſſes the Second; and the Second, aſſiſted by the Firſt, preſſes the Third; this, aſſiſted by the two preceding, preſſes the Fourth; and ſo on from Layer to Layer, through the whole Extent of the *Vortex*, Whence it follows, that in order to eſtimate the Quantity of Force with which a Layer tends towards the Surface of the *Vortex*, one muſt take the centrifugal Force proper to this Layer and that, which all the Matter of the Fluid contained under it acquires by Circulation. Q. E. D. Demonſtration.

Therefore the dilatative Effort of the Layers increaſes with the Layers in a greater Proportion than theſe Layers. Corollary I.

Therefore it is impoſſible to explain in the *Vortex*, how Gravity decreaſes in an inverted *Ratio* of the Squares of the Diſtances; and conſequently there will be nothing found in the *Vortex* to anſwer to Attraction, whoſe Exiſtence Sir *I. Newton* has ſo demonſtratively eſtabliſhed. Corollary II.

Thus we have re-eſtabliſhed in it's full Light the Difficulty, which M. *de Fontenelle* propoſed to M. *Villemot* in the Memoirs of the Academy Corollary III.

for the Year 1705 *. This learned Academician pretends, that as in the *Vortex* the lower Points ought to move faſter than the upper, in order to preſerve *Kepler*'s Aſtronomical Law; they ought alſo to have a greater centrifugal Force, and conſequently compel them to deſcend, particularly in Proportion to their Fluidity. The Objection made a great Noiſe, and the only Method found of getting rid of it, was by ſaying, that although each lower Point had more centrifugal Force than each upper; yet as the *Vortex* was in *Æquilibrium*, and the Sums of the Force of each of the two Layers were equal, there was no Reaſon why the lower *Stratum* ſhould get the better of the upper; becauſe this was as prevalent by the Number of it's Points, as that was by the Force of each of it's own.

But it is manifeſt, after what has been demonſtrated above, that the ſecond Layer, being aſſiſted by the firſt, muſt have a greater Force than the third, and conſequently compel it to deſcend, purſuant to the Principle then granted to Monſieur *Fontenelle*.

But if it be aſked, How could the upper Layer deſcend, ſeeing Matter is impenetrable?

I ſhall aſk in my turn, How, in an entire *Plenum*, do heavy Bodies fall to the Centre? And I reaſon on the Principle granted to M. *Fontenelle*.

But yet, becauſe what is allowed by one *Carteſian* is not always always allowed by all; let us ſuppoſe, that the upper Layer cannot deſcend; this, at leaſt, will follow from my Demonſtration, that, according to the Principles of all theſe Gentlemen, an upper Layer being preſſed by all the under ones, it muſt haſten it's Circulation, as long as it is ſlower than that of theſe under Layers; by reaſon that the Exceſs of their Velocities will act upon it, as if it had been at Reſt.

Corollary IV. Therefore the Layers of a *Vortex* will move all of a Piece, as do thoſe of a ſolid Sphere; and *Kepler*'s Law cannot poſſibly be preſerved. We ſhall now give other Proofs upon other Principles.

Theorem V. The Motion of the Points of the Equator is abſolutely independent of the Motion of the parallel Circles; and conſequently, in order to determine the *Æquilibrium* of the Points of the Equator, we muſt attend to nothing but it's Motion.

Demonſtration. The Plane of the Equator is parallel to the Planes of the other parallel Circles, that turn round the ſame Axe with it: It's centrifugal Force is perpendicular to the Tangent to the Sphere, which anſwers to it: It has not then any lateral Tendency towards theſe parallel Circles, and by a neceſſary Conſequence it's Motion is abſolutely independent of theirs.

And indeed, if it be ſuppoſed, that the Motion of the other parallel Circles ſtops, there is ſtill ſome Motion conceived in the Equator, juſt

* He afterwards publiſhed a Book intituled *Nouveau Syſteme*, ou *nouvelle Explication du Mouvement des* Planetes, *par M.* Philippe Villemot, *Prêtre, Docteur en Theologie*, &c. Lyon, 1707. in 12°.

as

as in the Caſe of the cylindrical *Vortex*: It is likewiſe conceivable, that the Velocity may be greater at the Equator than in the parallel Circles, as the Experiment already cited ſhews us: And if no Regard be had to the lateral Frictions, as the *Carteſians* would have it, who ſuppoſe them none or inſenſible, and as indeed they are obliged to ſay, that the *Vortex*, by the lateral Friction of the Equator, may not become cylindrical; this Equator will always continue to circulate uniformly, without communicating any of it's Velocity to the Points that laterally ſurround it. Therefore, *&c.* Q. E. D.

Therefore for the *Æquilibrium* of the Points of the Equator, it is neceſſary, at leaſt, that an upper Circumference ſhould have as much Tendency towards the Superficies of the *Vortex*, as another under concentric Circumference; becauſe, if it had leſs, there would be no *Æquilibrum*, even in the Principles of the *Carteſians*; and the under Circumference, preſſing the upper, would either make it deſcend, or communicate to it a Force equal to it's own. Wherefore, calling F the proper centrifugal Force of a Point of the upper Circumference, and f that of a Point of the under one; if S, s mark the different Sums of the Points contained in theſe two Circumferences, we ſhall have $F S = f s$. Corollary I.

Therefore the centrifugal Force does not diminiſh in the Plane of the Equator in the inverted *Ratio* of the Squares of the Diſtances from the Centre; for ſince $F S = f s$; $F . f :: s . S$. But the Points being ſuppoſed equal on both Sides, their Sums are as the Circumferences, and one has $s . S :: d . D$, which gives $F . f :: d . D$. inſtead of $:: d d . D D$. Corollary II.

Therefore *Kepler*'s Rules cannot be obſerved in the *Vortex*, or at leaſt in the Plane of it's Equator; for ſince $F . f :: d . D$; by putting in the Place of F, f, their Values, we ſhall have $\frac{V V}{D} . \frac{u u}{d} :: d . D$, and therefore $V = u$ and $D^2 . d^2 :: T T . t t$, whereas we ought to have $V . u :: \sqrt[2]{d} . \sqrt[2]{D}$ and $D^3 . d^3 :: T T . t t$. Corollary III.

There is here a *Fineſſe* of the *Carteſians* to be obſerved. Theſe Gentlemen conſider only the *Æquilibrium* of the ſpherical Layers of the *Vortex*, and from the Equality of their central Forces they deduce *Kepler*'s Laws, as well as they can. Remark.

But it is manifeſt, that whatever becomes of the Equality of Force in different ſpherical Superficies of the *Vortex*, there muſt be an *Æquilibrium* in the Plane of the Equator; becauſe it is in this Plane that the Planets move; and if there had not actually been an *Æquilibrium* between it's Points, they would ſoon place themſelves there, by reaſon that Fluids always tend to the Side where they are leſs preſſed; and it is by an actual *Æquilibrium* alone that they are kept in their Places; which entirely overturns the Theory of theſe Gentlemen.

Let us however grant to the *Carteſians*, that the Sums of the Forces of the two ſpherical Surfaces are equal; I cannot ſee, that they can thence infer, as they do, that the central Force diminiſhes in a reciprocal *Ratio*

of

of the Square of the Distance from the Centre. Let us examine their Argument:

F S = *f s*, say they; therefore F. *f* : : *s* . S; but *s*, S mark the Sums of the Points contained in the two Surfaces; therefore they are as these Surfaces, which, being as the Squares of their Distances, give F. *f* : : *d d* D D.

But it must be remarked, that the Surfaces of the *Vortex* are not Mathematical, they are Surfaces which have some Thickness: They cannot then be proportional to the Squares of their Distances from the Centre, except in the Case when their Thickness is equal. Now according to the *Cartesians*, the Points or Globules, which compose the *Vortex*, increase in Bulk according as they recede from the Centre; and, besides, they are homogeneous, or of an equal specific Density, at least in their common System. And consequently it is certain, that the different natural or real *Strata* of the *Vortex* are not of an equal Thickness, and that the Matter contained therein is not proportionate to the Squares of the *Radii* of these Surfaces, but only to the Squares of these *Radii* multiplied by the Thickness of the *Strata*, Therefore, *&c.* Q. E. D.

Corollary IV. Therefore, even allowing the *Cartesians*, what one has a Right (*Cor.* I. *Theor.* IV.) to refuse them, they will never be able to explain *Kepler*'s Rules in the *Vortex*; for it is only by the Proportion, which I have just now annulled, that they pretend to do it. See M. *de Moliere*'s *Leçons de Physique.*

And if it be objected, that I have not, in the preceding Corollaries, had any Regard to the Thickness of the Circumferences; I answer, that it was by way of pure Concession that I have not done it; and if any Person will be at the Pains of doing it, he will easily find, that *Kepler*'s Rules will only be the more disturbed thereby.

Conclusion. Therefore the *Vortex* is every way impossible, and insufficient in Natural Philosophy. It's mechanical Generation is impossible (*Part* I.); it has only an axifugal Force, and not a centrifugal and centripetal Force, as it should have (*Theor.* I. and II.); and even if it had, it cannot (*Theor.* III.) defend itself equally on all Sides. It is not sufficient for explaining Gravity, and it's Properties; it destroys *Kepler*'s Astronomical Laws. (*Coroll.* III. *Theor.* IV. and V.) What more can be desired, in order to conclude with Sir *Isaac Newton?* "Itaque hypothesis Vorticum (est impossibile &) "cum phænomenis astronomicis omnino pugnat, & non tam ad expli- "candos quam ad perturbandos motus cœlestes conducit." Q. E. D.

A short Account by James Parsons, *M. D. F. R. S. of a Book intituled,* Traité des Sens, *&c. by* M. le Cat, *M. D. F. R. S. printed at* Rouen, 1740. 8vo. No 466. p. 264. *Read* Dec. 16. 1742.

III. This Treatise appears, by the Advertisement prefixed to it, to be a Part of a Physiological Work, which the Author says is not likely to be soon published; and that he has therefore exhibited this Part for the Use of the Curious, and Lovers of Philosophy, who might not be so agreeably entertained by the rest of the Work, as treating chiefly of the Human Body, and therefore calculated rather for those of the Faculty of Medicine.

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He begins the Book with Page 201. and ſays he has, before, eſtabliſhed certain general Principles of *Senſation*, and that now he proceeds to recount the particular Parts with which Nature has furniſhed the animal Oeconomy, ſerving to our different Senſes; and then expatiates a little upon the general Utility of them.

Chap. I. treats of the Senſe of *Feeling*, wherein he has compiled all the different *Phænomena* that regard this Senſe, as thoſe of Heat, Cold, and other Objects of Feeling, with the Structure of the Skin, to which he thinks fit to ſubjoin two known Hiſtories, one of a blind Organiſt in *Holland*, who diſtinguiſhed all kinds of Coins, and played at Cards, by Feeling; and the other of the famous Statuary *Ganibaſius*, who, though ſtone-blind, could by Feeling make a Statue in Clay, perfectly like what he felt. Our Author adds ſomething of *Tickling*, and endeavours to prove, that Imagination has a great Share in the Cauſe of this Senſation, as well as the others; and thence he falls upon an Account of another Senſe, which he brings under this Head; which he calls, *la Chatouilment de l'Amour*, of which he gives a florid Definition.

Taſting is his next Subject, wherein, as in the foregoing Chapter, he has drawn together the ſeveral Sections relating to it, as, an Account of the Organs of Taſte, the Mechaniſm of *Savours*, and the manner of their being varied into compound Taſtes. His Compariſon here is new; he ſays, Since the Principles of Savours are Salts, both fixed and volatile, that Water, Earth, and Sulphur, ſerve to make the great Variety, and different Kinds, that are in Taſte, juſt as Shadows variouſly mingled with Light form different Appearances; not that the Shadow is capable of making an Impreſſion upon our Organs of Sight, but the Light alone; as the Salts alone are, upon our Organs of Taſte. He has alſo ſome Reaſoning upon the Difference that is in Mens Appetites to ſome Eatables, which were before diſagreeable. His Reaſon is, not that the Organs differ at any time from what they always were, but becauſe the Soul ſometimes changes her Ideas, even from the ſame Impreſſions, and that therefore there can be no Ideas eſſential to any Impreſſions; or at leaſt, that there are none which the Soul cannot change: He alſo ſays, that Imagination is much concerned in the Variation of Taſtes.

The Senſe of *Smelling* is diſcuſſed in his Third Chapter, wherein he obſerves the ſame Method as in the two former, in deſcribing the Mechaniſm of the Organs ſerving to that Senſe, and accounting for the Conveyance of Odours to thoſe Organs; and for the *Stimulus* of ſome odoriferous Particles cauſing Tears to flow, as well as Sneezing cauſed by a glaring Light; and, after making ſome Reflections on the many Effects of Smells upon the Human Body, and the exquiſite Senſe of Smelling in ſome Animals, he recites the Story told by Sir *K. Digby*, of the Boy brought up in a Foreſt, whoſe Smell was ſo exquiſite as to perceive the Approach of Enemies, and warn his Parents of them. Our Author found this Story elegantly told and reaſoned upon, in M. *Verduc*'s Book called, *Uſage des Parties*. He alſo mentions the Perfection of Smelling in the

Inhabitants

Inhabitants of the *Antibes*, who can run a Man upon the Noſe like a Hound; and concludes this Section with a Relation of a *Frier* of *Prague*, from the *Journals des Sçavans*, who could not only diſtinguiſh different Perſons from each other by ſmelling, but alſo an incontinent Woman from a chaſte one; and adds, in a joking Strain, that this Man had begun a Treatiſe of Odours before he died, which the Journaliſts much regretted the Loſs of: But, ſays M. *le Cat*, for my part, I do not know but a Perſon ſo exquiſite in this kind of Knowledge would be dangerous in Society.

He proceeds next to treat of *Hearing*, and brings under that Head the whole Mechaniſm and Doctrine of Sounds; the Vibrations of all ſounding Bodies: And from the Experiment of holding a Candle near any vibrating or ſounding Body, without the Flame's being moved or otherways affected, he argues that the common Air does not produce the Sound, but a more ſubtile Fluid better proportioned to the Organs of Hearing: Here he runs into a Detail of the Principles of the Chords and Tones of Muſic, and makes a new and curious Compariſon between the principal Colours in the Rays of Light, and the foreſaid Fluid, which is more or leſs ſubtile in the Air, ſome Particles of which are only capable of being moved to expreſs low Tones, others higher, and ſo on ſucceſſively, as far as the Compaſs of Muſic reaches; juſt as the Light is compoſed of certain kinds of Rays, ſome of which produce *Red*, ſome *Green*, *&c.* This being ſuppoſed, ſays he, it may be conceived, that every Tone will move the Fluid that is proper to itſelf; and by that means the Ear may receive at once the Impreſſions of every Fluid, as the Eye receives the Impulſions of ſeveral coloured Rays at the ſame Inſtant. He adds to this, by way of Reaſoning, that when a ſingle String of an Inſtrument is touched, though the generality of Mankind can diſtinguiſh but one Tone, which he calls the *fundamental Sound*, yet People accuſtomed to Harmony can diſtinguiſh, beſides, an *Octave*, a *Fifth*, and a *Third*, covered by this *fundamental Tone*; for the *Octave* is half that Sound, or the Produce of half the String; the *Fifth* is the Produce of $\frac{2}{3}$, and the *Third* is the Produce of $\frac{4}{5}$ of the ſame String.

He proceeds to reaſon upon this in an agreeable Manner, and concludes his above-mentioned Compariſon to this purpoſe: Thus there are in the vibrated String all the Harmonies or Chords at once which compoſe the *fundamental Sound*, by vibrating each it's particular proper Fluid at the ſame Time; juſt as the Aſſemblage of all the different primitive coloured Rays meeting together, makes the white Colour or Light: And ſo the Ear of a good Muſician is a kind of *Priſm*, which can ſeparate and diſtinguiſh the Sounds or Tones from each other in the *fundamental Sound*. He gives an anatomical Deſcription of the Organs of Hearing; and has added ſome good Figures of the external and internal Parts of the Ear, with the *Euſtachian* Tube, much after the manner of *Du Verney*.

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He has alſo the Figure of an Inſtrument, Page 292, to help thoſe that are hard of Hearing, which he claims the Invention of. The particular *Form* of this Inſtrument may be new to the Author; yet we have had of this Kind in Uſe many Years in *England* for the ſame Purpoſe. He finiſhes this Section with ſome Reflections upon a young Man of a Town called *Chartres*, who was born deaf and dumb, and whoſe Hearing ſuddenly came to him, and who ſpoke ſome Months after. In this Place he has a very good Figure of the *Baſis Cerebri*, by a tranſverſe Section through the *Frontal Sinuſes* a little above the Eyes, and continued through the *temporal Bones*; demonſtrating the *Originations* and *Exit* of the Nerves, with the Conjunction of the *vertebral* and *carotid Arteries*, according to the Diſſection of the famous *Willis*; and then proceeds to his laſt Section, which treats of *Seeing*.

This Section, in a Word, is on the Structure of the Eye, and all the *Phænomena* of Viſion. He begins it with the Doctrine of *Lights* and *Colours*, making uſe of many Experiments and Explanations of the great Sir *Iſaac Newton*; having alſo added ſeveral of his own, beſides ſome little Cavils, a mere *Jeu des Mots*, againſt that great Man's Doctrine of *Attraction*, to which he prefers the *Impulſion* of *Carteſius*. He quotes againſt Sir *Iſaac*, *M. de Fontaine*, *M. Bannier*, and *M. Voltaire*; and as our young Author had a Mind to oppoſe the Opinions of one of the greateſt Abilities in the Sciences, common Prudence ſhould have informed him, that the Name *Newton* beſpeaks the greateſt Modeſty and Diffidence in the Attempt. Our Author amuſes himſelf thus againſt that *Prince* of Philoſophers, which is the more ſtrange; ſince if he had wrote nothing on the Subject, *M. le Cat* would have wanted a great Part of his Furniture for this Section.

The principal Authors beſides, regarding Anatomy and Phyſiology, which our Author ſeems to have had in his View, are *Du Verney*, *Willis*, *Synac* upon *Heiſter*, and *Verduc*'s excellent Book *L'Uſage des Parties*. However, this *Treatiſe* of the Senſes is judiciouſly compiled; nor does it want ſeveral ingenious Embelliſhments from the Author, beſides the Opinions of ſeveral others; we may therefore conclude it to be a very uſeful Book.

IV. 1. Firſt, I have found that all Bodies (metallick, ſoft, or fluid ones excepted) may be made Electrick, by firſt heating them more or leſs, and then rubbing them on any ſort of Cloth. So that all kinds of Stones, as well precious as common, all ſorts of Wood, and, in general, every thing that I have made Trial of, became Electrick, by heating and rubbing; except ſuch Bodies as grow ſoft by Heat, as the Gums, which diſſolve in Water, Glue, and ſuch other Subſtances. 'Tis alſo to be remarked, that the hardeſt Stones and Marbles require more chafing or heating than others, and that the ſame Rule obtains with regard to the Woods; ſo that Box, *Lignum Vitæ*, and ſuch others muſt be chafed almoſt to the Degree of burning, whereas *Fir*, *Lime-Tree*, and *Cork*, require but a moderate Heat.

Concerning Electricity, *by* *M.* Du Fay, *F. R. S. and R. Acad. Sc.* Paris, *tranſlated from the* French, *by* T. S. *M. D.* No. 431. p. 258. *dated* Paris, *Dec.* 27, 1733.

Secondly, Having read in one of Mr *Gray*'s Letters *, that Water may be made Electrical by holding the excited Glaſs Tube near it (a Diſh of Water being firſt fixed to a Stand, and that ſet on a Plate of Glaſs, or on the Brim of a Drinking-Glaſs, previouſly chafed, or otherwiſe warmed) I have found upon Trial, that the ſame thing happened to all Bodies without Exception, whether ſolid or fluid; and that for that Purpoſe it was ſufficient to ſet them on a Glaſs-Stand ſlightly warmed, or only dried; and then by bringing the Tube near them, they immediately became Electrical. I made this Experiment with Ice, with a lighted Wood-coal, and with every thing that came into my Mind; and I conſtantly remarked, that ſuch Bodies as of themſelves were leaſt Electrical, had the greateſt Degree of Electricity communicated to them at the Approach of the Glaſs Tube.

Thirdly, Mr *Gray* ſays, towards the End of one of his Letters †, that Bodies attract more or leſs according to their Colours. This led me to make ſeveral very ſingular Experiments. I took 9 ſilk Ribbons of equal Size, one white, one black, and the other 7 of the 7 primitive Colours, and having hung them all in Order on the ſame Line, and then bringing the Tube near them, the black one was firſt attracted, the white one next, and the others in Order ſucceſſively to the red one, which was attracted leaſt, and the laſt of them all. I afterwards cut out 9 ſquare Pieces of Gauſe, of the ſame Colours with the Ribbons, and having put them one after another on a Hoop of Wood with Leaf-Gold under them, the Leaf-Gold was attracted thro' all the coloured Pieces of Gauſe, but not thro' the white or black. This inclined me at firſt to think, that the Colours contributed much to Electricity. But 3 Experiments convinced me of the contrary: The firſt, that by warming the Pieces of Gauſe, neither the black nor white Pieces obſtructed the Action of the electrical Tube more than thoſe of the other Colours. In like manner, the Ribbons being warmed, the black and white are not more ſtrongly attracted than the reſt. The ſecond is, the Gauſes and Ribbons being wetted, the Ribbons are all attracted equally, and all the Pieces of Gauſe equally intercept the Action of electrick Bodies. The third is, that the Colours of a Priſm being thrown on a Piece of white Gauſe, there appear no Differences of Attraction. Whence it follows, that this Difference proceeds not from the Colour, as a Colour, but from the Subſtances that are employed in the dying. For when I coloured Ribbons, by rubbing them with Charcoal, Carmine, and ſuch other Subſtances, the Differences no longer proved the ſame.

Fourthly, Having communicated the Electricity of the Tube by means of a Packthread, after Mr *Gray*'s manner, I obſerved, that the Experiment ſucceeded the better for wetting the Line; and that it may be ſupported on Glaſs-Tubes inſtead of Silk-Lines. And I made this Experiment at 1256 Feet Diſtance, in a Garden, tho' the Wind was high,

* Vol. VI. Part ii. Chap. i. §. iii. 3. † Ibid. Art. 2.

and

and that the Line made 8 Returns, and paſſed thro' 2 different Walks. By means of 2 Silk Loops I adjuſted 2 Lines in ſuch a manner, that their Ends were but a Foot diſtance from one another, and I remarked that the Electrick Virtue was ſtill communicated. I have ſince that ſeen *, that Mr *Gray* had the ſame Thought, and that he had done the ſame with Rods. This Experiment put me upon placing ſeveral different Bodies between the two Lines, in order to examine which diminiſhed or intercepted the Electricity, and which gave no Obſtruction to it; I have given the *Academy* an Account of the Particulars, which I now omit for the Sake of Brevity.

Fifthly, I ſuſpended a Child on Silk Lines, and made all the ſurpriſing Experiments deſcribed by Mr *Gray* †. But having tried the Experiment upon my own Body in the ſame manner, I obſerved ſeveral things very remarkable. Firſt, when I take the Paſte-board or Stand, on which the Leaf-Gold is laid, into my Hand, neither my other Hand nor my Face has any Attraction. But if another Perſon, who is in the Chamber, comes near me, he will attract it with his Face, his Hand, or even with a Stick. Secondly, while I am ſuſpended on the Lines, if the electrick Tube be put near one of my Hands, or my Legs, and then if another Perſon approach me, and paſs his Hand within an Inch or thereabouts of my Face, Legs, Hand, or Cloaths, there immediately iſſues from my Body one or more pricking Shoots, with a crackling Noiſe, that cauſes to that Perſon as well as to my ſelf, a little Pain reſembling that from the ſudden Prick of a Pin, or the burning from a Spark of Fire, which is as ſenſibly felt thro' one's Cloaths, as on the (bare) Hand or Face. And in the Dark, theſe Snappings are, as may be eaſily imagined, ſo many Sparks of Fire. Theſe Snappings, or Sparks, are not excited, if a Bit of Wood, Cloth, or any other Subſtance than a living Body be paſſed over the Perſon ſuſpended on the Lines, unleſs it be a Piece of Metal, which produces very nearly the ſame Effect. Any other living Animal doth the ſame, if put on the Lines, and that firſt the Tube, and then the Hand be applied near it: But it is otherwiſe, if the Experiment be made with the Carcaſs of an Animal; for then one perceives only, if it be in the Dark, a ſtill uniform Light, without Snappings or Sparks. I omit many other Circumſtances of leſs Importance, though curious, to avoid running into too great a Length.

Sixthly, On making the Experiment related by *Otho de Guerik*, in his Collection of Experiments *de Spatio Vacuo*, which conſiſts in making a Ball of Sulphur rendered Electrical, to repel a Down-Feather, I perceived that the ſame Effects were produced not only by the Tube, but by all electrick Bodies whatſoever; and I diſcovered a very ſimple Principle, which accounts for a great Part of the Irregularities, and if I may uſe the Term of the Caprices that ſeem to accompany moſt of the Ex-

* Vol. VII. Part. iv. Chap. iv. † Vol. VI. Part ii. Chap. i. §. iii. 2.

periments on Electricity. This Principle is, that electrick Bodies attract all thoſe that are not ſo, and repel them as ſoon as they are become electrick, by the Vicinity or Contact of the electrick Body. Thus Leaf-Gold is firſt attracted by the Tube, and acquires an Electricity by approaching it; and of conſequence is immediately repelled by it. Nor is it re-attracted, while it retains it's electrick Quality. But if, while it is thus ſuſtained in the Air, it chance to light on ſome other Body, it ſtraightways loſes it's Electricity; and conſequently is re-attracted by the Tube, which, after having given it a new Electricity, repels it a ſecond time; which continues as long as the Tube keeps it's Electricity. Upon applying this Principle to the various Experiments of Electricity, one will be ſurprized at the Number of obſcure and puzzling Facts it clears up. For Mr *Hauksbee's* famous Experiment of the Glaſs Globe, in which Silk Threads are put, is a neceſſary Conſequence of it. When theſe Threads are ranged in Form of Rays by the Electricity of the Sides of the Globe, if the Finger be put near the Outſide of the Globe, the Silk Threads within fly from it, as is well known; which happens only becauſe the Finger, or any other Body applied near the Glaſs Globe, is thereby rendered electrical, and conſequently repels the Silk Threads, which are endowed with the like Quality. With a little Reflection one may in the ſame manner account for moſt of the other *Phænomena*, and which ſeem inexplicable, without attending to this Principle.

Seventhly, Chance has thrown in my Way another Principle, more univerſal and remarkable than the preceding one, and which caſts a new Light on the Subject of Electricity. This Principle is, that there are two diſtinct Electricities, very different from one another; one of which I call *vitreous Electricity*, and the other *reſinous Electricity*. The firſt is that of Glaſs, Rock-Cryſtal, Precious Stones, Hair of Animals, Wool, and many other Bodies: The ſecond is that of Amber, Copal, Gum-Lack, Silk, Thread, Paper, and a vaſt Number of other Subſtances. The Characteriſtick of theſe two Electricities is, that a Body of the *vitreous Electricity*, for Example, repels all ſuch as are of the ſame Electricity; and, on the contrary, attracts all thoſe of the *reſinous Electricity*; ſo that the Tube, made electrical, will repel Glaſs, Cryſtal, Hair of Animals, *&c.* when rendered electrick and will attract Silk, Thread, Paper, *&c.* though rendered electrical likewiſe. Amber, on the contrary, will attract electrick Glaſs, and other Subſtances of the ſame Claſs, and will repel Gum-Lac, Copal, Silk, Thread, *&c.* Two Silk Ribbons rendered electrical, will repel each other; two Woollen Threads will do the like; but a Woollen Thread and a Silk Thread will mutually attract one another. This Principle very naturally explains, why the Ends of Threads, of Silk, or Wool, recede from one another in Form of a Pencil or Broom, when they have acquired an electrick Quality. From this Principle one may with the ſame Eaſe deduce the Explanation of a great Number of other *Phænomena*. And 'tis probable, that this Truth will lead us to the further Diſcovery of many other things.

In Order to know immediately, to which of the two Claſſes of Electricity belongs any Body whatſoever, one need only render Electrical a Silk Thread, which is known to be of the *reſinous Electricity*, and ſee whether that Body, rendered Electrical, attracts or repels it. If it attracts, 'tis certainly of that kind of Electricity which I call *vitreous*; if on the contrary it repels, 'tis of the ſame kind of Electricity with the Silk, that is, of the *reſinous*. I have likewiſe obſerved that communicated Electricity retains the ſame Properties: For if a Ball of Ivory, or Wood, be ſet on a Glaſs Stand, and this Ball be rendered electrick by the Tube, it will repel all ſuch Subſtances as the Tube repels; but if it be rendered electrick by applying a Cylinder of Gum-Lac near it, it will produce quite contrary Effects, *viz.* preciſely the ſame as Gum-Lac would produce. In order to ſucceed in theſe Experiments, 'tis requiſite that the two Bodies, which are put near one another, to find out the Nature of their Electricity, be rendered as electrical as poſſible; for if one of them was not at all, or but weakly electrical, it would be attracted by the other, though it be of that Sort, that ſhould naturally be repelled by it. But the Experiment will always ſucceed perfectly well, if both the Bodies are ſufficiently electrical.

Experiments and Obſervations upon the Light that is produced by communicating Electrical Attraction to animal or inanimate Bodies, together with ſome of it's moſt ſurpriſing Effects, by Mr Stephen Gray. *F.R.S.* No 436. p. 16. *dated* Charter-Houſe, Jan. 28th, 1734-5.

2. It is no ſmall Satisfaction to me, that my Electrical Diſcoveries have not only been confirmed by ſo judicious a Philoſopher as Mr *Dufay*; but that he has made ſeveral new ones of his own, more eſpecially that important luciferous one, which put me upon making the Experiments I am now going to relate.

I ſhall firſt give ſome Account of the Experiments made the laſt *Spring*, ſoon after I received the Tranſlation of Mr *Dufay*'s Letter; then of thoſe we made at my honoured Friend's, *Granvill Wheler*, Eſq; *F.R.S.* in the Months of *July* and *Aug.* and laſtly proceed to thoſe I have made ſince my Return to *London*, which was in *Sept.* laſt.

As I had not any ſilk Lines by me ſtrong enough to bear the Boy, I cauſed him to ſtand on ſome of the Electric Bodies; and, as I concluded, found the Effect the ſame as mentioned by Mr *Dufay*. I ſhall not need to mention the Particulars of the Experiment, but proceed to thoſe that were ſuggeſted to me upon Mr *Dufay*'s ſaying, that theſe Snappings or Sparks are not excited, if a Piece of Wood, or any other Subſtance than a living Body, be paſſed over the Perſon ſuſpended on the Lines, unleſs it be a Piece of Metal: from thence I concluded, that if I ſuſpended the Metal upon ſilk Lines, or laid it upon any of the Electric Bodies, the Effect muſt be the ſame, when the Metal had been made Electrical by the Tube, and the Hand of any one was held near it, and found it ſucceeded accordingly. I began firſt with ſome common Utenſils that were at Hand, ſuch as the Iron Poker, Tongs, and Fire Shovel; any of theſe being ſuſpended upon Lines of the largeſt ſewing Silk, then the excited Tube, being applied firſt to the Knob of the Poker, and after it the Hand, there was the Snap and Pricking felt, as I expected; and the Effect was the ſame, when the Tube was firſt applied to the other End

of

of the Poker. I had by me a three pronged Iron Inſtrument, which was made many Years ago; it's Uſe was deſigned for propping up the Obſervatory Table, when I obſerved the Spots in the Sun; the Prongs were about half an Inch Diameter, two of them about 22 Inches, and the third about 8 Inches long; they were tapering towards the Ends, and pointed: This being laid either upon Cylinders of Glaſs, Cakes of Roſin and Bees Wax, or on a Cake of Sulphur, the Tube being applied to the End of any of the Legs, the Hand or Cheek being applied near the other, both the other Legs had the ſame Effect as that to which the Tube had been applied; but by holding my Cheek near any of the Points of the Legs, the pricking or burning Pain was much more ſenſibly felt, and was ſometimes felt for ſeveral Minutes after. I was not ſo inquiſitive at that Time about making the Experiment in the Dark, that I might ſee the Light proceeding from the Iron, not thinking the Electricity communicated to the Metals would have produced ſo ſurpriſing Phænomena, as by the following Account of the Experiments will be deſcribed.

1. I come now to give ſome Account of the Experiments we made at Mr *Wheler*'s, beginning firſt with the Succeſs we had in repeating Mr *Dufay*'s Experiment. Mr *Wheler*, ſoon after my coming to him, procured ſilk Lines ſtrong enough to bear the Weight of his Footboy, a good ſtout Lad; then having ſuſpended him upon the Lines, the Tube being applied to his Feet or Hands, and the Finger of any one that ſtood by held near his Hands or Face, he found himſelf pricked or burnt, as it were by a Spark of Fire, as Mr *Dufay* had related, and the ſnapping Noiſe was heard at the ſame Time; but it did not ſucceed with us, when we applied our Hands to any Part of his Body through his Cloaths, except upon his Legs, upon which he felt the Pain through his Stockings, although they were very thick ones.

2. Being deſirous to make the Experiment upon another Species of Animals, we took a large white Cock and ſuſpended him upon the Lines firſt alive, and the Effect was the ſame as on the Boy, whether we applied our Fingers to any Part of his Body, or our Cheek to his Beak, Comb or Claws; then the Cock was killed, and put on the Lines again, and we found very little, if any, Difference, from the Effect it had on us when the Cock was living: We then cauſed the Cock to be ſtripped of his Feathers, and the Difference from what has been ſaid before was not very great.

3. We took a large Sirloin of Beef, that came from an Ox that had been killed two Days before, and ſuſpended it on the ſilk Lines; then the Fingers held near any Part of it, there was a Snapping, and the Fingers were puſhed or pricked; but the Snapping was thought not to be quite ſo loud as when the Experiment was made on the Cock.

4. We cauſed to be made an Iron Rod, 4 Foot long, and about half an Inch Diameter, pointed at each End, but not ſharp, being left about the Bigneſs of a Pin's Head, this being ſuſpended on the Lines; then the Tube being rubbed, and held near one End of the Rod, and then the

Finger

Finger or Cheek being put near either End of the Rod, the Effect was the ſame as when an Animal had been ſuſpended on the Lines, with reſpect to the pricking Pain we felt.

5. At Night we made the luminous Part of the Experiment, ſuſpending the Iron Rod on the Silk Lines; then applying one End of the Tube to one End of the Rod, not only that End had a Light upon it, but there proceeded a Light at the ſame Time from the other, extending in Form of a Cone, whoſe Vertex was at the End of the Rod, and we could plainly ſee that it conſiſted of Threads, or Rays of Light, diverging from the Point of the Rod, and the exterior Rays being incurvated. This Light is attended with a ſmall hiſſing Noiſe; every Stroke we give the Tube, cauſes the Light to appear: The Hiſſing ſeems to begin at that End of the Rod next the Tube, and as it comes, increaſes in it's Loudneſs, but it is ſo ſmall as not to be heard without good Attention, and by thoſe only that ſtand at that End of the Rod from whence the ſaid Light proceeds.

Mr *Godfrey* being deſirous to ſee theſe Experiments, I repeated them, by laying a Rod of Iron upon a Cake of Shell-Lack, which was laid upon a Glaſs Veſſel; but the Effects being much the ſame with what has been above-mentioned, I ſhall not need to mention any other Particulars.

1. I ſhall now proceed to give ſome Account of the Experiments I have made ſince my Return to *London*, which was in *Sept.* laſt. I cauſed 3 Iron Rods to be made, one of 4 Feet long, two, each 3 Feet in Length; one of theſe was made tapering toward the Ends, and pointed as that of 4 Feet was; the other pointed at one End, and the other End not pointed, the Diameter of the Rods about half an Inch; they were firſt forged, then filed and burniſhed. With theſe I made the following Experiments: When any of them were laid either upon the Brims of hollow Cylinders of Glaſs well warmed, or upon Cakes of Roſin and Bees Wax, or upon thoſe of Sulphur, the Phænomenon was the ſame as when they had been ſuſpended on Silk Lines: But now I diſcovered another very ſurpriſing one, *viz.* that after the Tube had been applied, and the Light ſeen at both Ends, upon my going to the other end of the Rod, when there was no Light to be ſeen, upon holding my Hand at ſome diſtance from it, then moving my Hand towards it with a pretty ſwift Motion, there iſſued from that Point of the Rod a Cone of Light, as when the Tube had been applied to the other End; and upon repeating this Motion of my Hand, the ſame Phænomenon appeared for five or ſix times ſucceſſively, only the Rays were each time ſhorter than the other; theſe Lights are alſo attended with a hiſſing Noiſe: That Light which appears upon that End next the Tube, when it is held obliquely to the Axis of the Rod, has it's Rays tending towards it: All the Time I am rubbing the Tube, theſe Flaſhes of Light appear upon every Motion of my Hand up or down the Tube, but the largeſt Flaſhes are produced by the Motion of my Hand downwards.

2. When

2. When 2 or 3 Rods are laid either in a right Line, or making any Angle with each other, or either touch, or are at a ſmall Diſtance from one another, the Tube being applied to one of their Ends, the furtheſt End of the further Rod, exhibits the ſame Phænomena as one ſingle.

3. An Experiment with the Rod that was pointed at but one of it's Ends. When the Tube is applied to the other End of the Rod, the Point gives the ſame Appearance and a like Effect with the Rods, that are pointed at each End; but the great End of the Rod, when the Hand or Cheek is applied near it, gives but one ſingle Snap; but this is much louder than the greateſt of thoſe from the Point of the Rod, and one feels a little more Pain by it.

4. I cauſed an Iron Ball to be forged, and then turned and burniſhed; 'twas 2 Inches Diameter, which being placed on a wooden Stand, that had a ſmall Concave at the Top, in which the Ball was placed; the Stand being ſet upon a Cylindrick Glaſs, then the excited Tube being applied near the Ball, there proceeded a Stream of Light from it, with a ſmall hiſſing Noiſe; then putting my Finger or Cheek near the Ball, there was no Snapping, nor any Pain felt, yet there appeared a very bright Light.

5. The Rod of 4 Feet long, being placed upon a Stand, that had a croſs Arm with a Groove in it to receive the Rod; then the Stand being placed on the Glaſs Cylinder, they were ſet at ſuch a Diſtance, as that one of the Points of the Rod might juſt touch the Ball over againſt it's Centre; then going to the other End of the Rod with the prepared Tube, and applying it as uſual, when I came to the Ball, the Hand or Cheek being near it, cauſed a loud Snap, compared to thoſe made by the Points of the Rods, and the Pain of pricking or burning was more ſtrongly felt, the Light alſo was brighter and more contracted: I then placed the Rod with it's Point at an Inch diſtance from the Ball, and applying the Rod as before, I came to the Ball, and touching it with my Hand or Finger, there not only appeared a Light on the Ball, but there alſo proceeded a Bruſh of Light from the Point of the Rod after the ſame manner as when the Experiments had been made with the Rods only.

6. An Experiment made with the 4 Feet Rod, and a Braſs Plate 4 Feet ſquare. This was placed upon a Stand, ſo that the Plate ſtood perpendicular, the Stand being ſet on the Cylindrick Glaſs; then the Rod with it's Stand and Glaſs was ſet ſo as that one Point of it was about an Inch from the Centre of the Plate; then the Tube being applied to the other End of the Rod, and after going to the Plate, on ſtriking it gently with my Finger on the back Side, a Light appeared upon the Plate, and at the ſame Time the Bruſh of Light came out from the Point of the Rod; and when my Hand or Cheek was held near any of the Angles of the Plate, there was a Light came from thence with a ſmall hiſſing Noiſe, and the Pricking was felt as when the Experiments were made with the pointed Rods.

7. A Pewter Plate being laid upon the Stand, which had been ſet upon a Glaſs Cylinder, the Tube firſt, and then the Finger applied, there appeared a Light upon the Plate, and the End of the Finger was puſhed; and when the Cheek was held near the Edge of the Plate, there was a Snapping heard, but not ſo loud as when Iron Rods were uſed. I then filled the Plate with Water, and applying the Tube and Finger as before, there was the ſame Light, puſhing of the Finger, and ſnapping, as when the Experiment was made with the empty Plate. When the Experiment is made with Water by Day-light, by applying the End of the Finger near the Surface of the Water, it appears to riſe in a little Hill, and upon the ſnapping Noiſe falls down again, putting the Water into a waving Motion near the Place where the Water had riſen.

8. I then took a wooden Diſh, and placed it upon the Stand, firſt empty; then applying the Tube, and the Finger held near the Diſh, there appeared a Light, but no puſhing of the Finger nor ſnapping: I then filled the Diſh with Water, and the Tube being held over the Surface of the Water, there appeared a greater Light than when the Finger had been applied to the empty Diſh, but no ſnapping, till by holding the Tube after it had been well rubbed, within two or three Inches of the Finger that was held near the Surface of the Water, and then the Finger was puſhed, and a ſnapping Noiſe heard, as when the Experiment was made with the Pewter Plate.

By theſe Experiments we ſee, that an actual Flame of Fire, together with an Exploſion, and an Ebullition of cold Water, may be produced by communicative Electricity; and altho' theſe Effects are at preſent but *in minimis*, it is probable, in Time there may be found out a Way to collect a greater Quantity of it; and conſequently, to increaſe the Force of this electrick Fire, which, by ſeveral of theſe Experiments (*Si licet magnis componere parva*) ſeems to be of the ſame Nature with that of Thunder and Lightning.

Some Experiments relating to Electricity, by the ſame. No. 439. p. 166. *Dated* June 12, 1735.

3. *Feb.* 18, I tried what Effect would be produced on ſeveral Sorts of Wood with reſpect to the luminous Part of Electricity; the Wood was made into Rods of the ſame Form with thoſe Iron ones mentioned in my former Letter; the Woods made uſe of were Fir, Aſh, and Holly; theſe being ſucceſſively diſpoſed upon electrick Bodies, after the ſame manner as the Iron Rods had been, the Tube being applied to one End, there appeared a Light on it, but not with ſo great a Force, nor did the Light extend to ſo great a length; neither was the Form of it conical, but rather cylindrical; but the Extremity of it ſeemed to conſiſt of a ſhort Fringe of Light; when the Light, that was given to the Rod by the Application of the Tube, did ceaſe, upon a Motion of my Hand towards the Point of the Rod, the Light came out again, as has been mentioned of the Iron Rods; but when the Hand or Finger was held near the Point of theſe wooden Rods, there was no pricking or puſhing of the Finger felt, as when the Iron Rods were made uſe of. I had ſome of theſe Rods made much bigger at one End than the other,

and now applying my Finger to the larger End, there not only appeared a Light, but the Finger was puſhed, more eſpecially when the Holly Rod was made Uſe of, and the Cheek was a little pricked, but the Smart was not near ſo great, as when the Iron Rods were uſed; the great End of the Rod was pointed with a much larger Angle than the leſſer one, yet there was very little, if any Difference, in the Form, or Bigneſs of the Light that proceeded from either End.

Having procured me 2 Pair of Lines made of Worſted Yarn, one of them of a Mazareen blue, the other of a ſcarlet Colour; on the 3d of *April*, I ſuſpended the Boy firſt on the blue Lines, and found that all the Effects were the ſame, as when he was ſuſpended on Lines of blue Silk. I then ſuſpended him upon the ſcarlet Lines, but now though the Tube were as well excited, and the Experiment often repeated, yet there was no Effect produced on him, either of Attraction of a pendulous Thread, nor of pricking or burning, by applying one's Hand near him; I then laid one of the Iron Rods firſt upon the blue Lines, and all the ſame Effects were exhibited, as when the ſame Rod had been laid on Silk Lines of that Colour; but upon laying the ſame Rod upon the Scarlet Lines, no Manner of Attraction, *&c.* was perceived.

In *Philoſ. Tranſact.* No. 422*, I gave an Account of the Experiments I made upon the communicative Electricity of Water, and that Water is attracted by the Tube, together with ſeveral remarkable Circumſtances with which this Attraction is attended; but I have now found, that when the Stand with thoſe little Ivory Cups there mentioned, be ſet upon any electrick Body, the ſame Phænomena are produced, not only by holding the Tube near the Water, but when that is removed, and the Tip of the Finger placed over the Water, *viz.* there is a little Hill, or Protuberance of Water of a conical Form, from the Vertex of which proceeded a Light and a ſmall ſnapping.

May 6, we made the following Experiment. The Boy being ſuſpended on the Silk Lines, and the Tube being applied near his Feet as uſual; upon his holding the End of his Finger near a Gentleman's Hand, that ſtood on a Cake made of Shell Lack and black Roſin; at the ſame Time another Gentleman ſtood at the other Side of the Boy with the pendulous Thread; then the Boy was bid to hold his Finger near the firſt Gentleman's Hand, upon which it was pricked, and the ſnapping Noiſe was heard; and at the ſame Time, the Thread which was by it's Attraction going towards the Boy fell back, the Boy having loſt a great Part of his Attraction, upon a ſecond moving his Finger to the Gentleman's Hand, the Attraction ceaſed; then the Thread being held near that Gentleman, he was found to attract very ſtrongly; but having ſince repeated this Experiment, I find that though the Attraction of the Boy is much diminiſhed, yet he does not quite loſe it, till 2, 3, and ſometimes 4 Applications of his Finger to the Hand of him that ſtands on the elec-

* Vol. VI. Part ii. Chap. i. § iii. 3.

trick

trick Body, but without touching him. At another Time I caused 3 Persons to stand, one of them upon a Cake of Shell Lack, &c. the other upon one of Sulphur, the third upon a Cake of Bees-Wax and Rosin; the Persons all holding Hands, the Boy applying his Finger near the first Man's Hand, they all three became electrical, as appeared by the Attraction of the Thread, when held near to any of them.

P. S. *A Repetition of some of these Experiments, and an Addition of some others made* June 10.

June 10. in the Morning, I repeated the Experiments with the wooden Rods, the most material ones of which were made with the Holly Rod: This being laid on the Glass Cylinder, and a Fir Board about a Foot square and three tenths of an Inch thick being placed erect upon a Stand, that was set on another Glass Cylinder, so that the Center of the Board was placed near the Point of the Rod, but not to touch it by near half an Inch; then the Tube being held near the great End of the Rod, there issued out a Light from the little End of the Rod, which was that next the Board; and, as the Boy told me, it came along with a hissing Noise, and struck against the Board; when he touched the Board, there was a Light; and at the same time, another on the End of the Rod, but he heard no snapping nor pricking of his Finger, as when the Brass Plate and Iron Rod were made use of.

Experiments with the Scarlet and Blue Worsted Yarn repeated.

When the Boy was suspended upon the scarlet Lines, he attracted the white Thread at a very small Distance, but the Attraction ceased in about 6 or 7 Seconds of Time. Then the Boy being taken off, an Iron Rod was laid on the Lines, but there was no Attraction of the Thread by the Body of the Rod; but when the Thread was held near either of the pointed Ends of it, there was a small Repulsion of it, and in the Dark a very small Light was seen at each End of the Rod.

When the Boy was suspended upon the blue Lines, he attracted the Thread to him when it was held at least a Foot distance from him, and continued his Attraction to near 75 Seconds, the Iron Rod continued it's Attraction not more than 36 Seconds.

Experiments made in the Afternoon upon the Boy, when he was suspended upon Silk Lines of several Colours.

When he was suspended on the blue Lines, he continued his Attraction 50 Minutes, on the Scarlet Lines 25 Minutes, on the Orange coloured Lines 21 Minutes.

By these Experiments we see the Efficacy of Electricity upon Bodies suspended upon Lines of the same Substance, but of different Colours, and also that the Attraction continues much longer upon Silk than upon Yarn, and consequently Silk is the propereſt Body we can make Use of to suspend those Bodies upon, to which we would communicate an Electricity.

Concerning the Revolutions which small pendulous Bodies will, by Electricity, make round larger ones from West to East, as the

4. I have lately made several new Experiments upon the projectile and pendulous Motion of small Bodies by Electricity, by which small Bodies may be made to move about larger ones, either in Circles or Ellipses, and that either concentrical or excentrical to the Center of the larger Bodies about which they move, so as to make many Revolutions about them; and this Motion will be constantly the same Way that the Planets move about the Sun, *viz.* from the Right to the Left, or from West to East:

Planets do round the Sun, by Mr Stephen Gray, *F.R.S.* No. 441. p. 220. *Dated* Feb. 6, $173\frac{5}{6}$.

But theſe little *Planets*, if I may ſo call them, move much faſter in their *Apogeon*, than in the *Perigeon* Parts of their Orbits; which is, as you very well know, directly contrary to the Motion of the Planets about the Sun.

Electrical Experiments by the ſame, taken from his Mouth by C. Mortimer, *M. D. R. S. Secr.* Feb. 14, $173\frac{5}{6}$. *being the Day before he died.* No. 444. p. 400.

5. Take a ſmall Iron Globe of an Inch or Inch and half Diamenter, which ſet on the Middle of a Cake of Roſin of about 7 or 8 Inches Diameter, having firſt excited the Cake by gently rubbing it, clapping it 3 or 4 times with the Hands, or warming it a little before the Fire; then faſten a light Body, as a ſmall Piece of Cork, or Pith of Elder, to an exceeding fine Thread, 5 or 6 Inches long, which hold between your Finger and Thumb, exactly over the Globe, at ſuch an Height, that the Cork, or other light Body, may hang down about the Middle of the Globe: This light Body will of itſelf begin to move round the Iron Globe, and that conſtantly from Weſt to Eaſt, being the ſame Direction which the Planets have in their Orbits round the Sun. If the Cake of Roſin be circular, and the Iron Globe placed exactly in the Centre of it, then the light Body will deſcribe an Orbit round the Iron Globe, which will be a Circle; but if the Iron Globe be placed at any Diſtance from the Centre of the circular Cake, then the light Body will deſcribe an [Elliptical] Orbit, which will have the ſame Excentricity as the Diſtance of the Globe from the Centre of the Cake.

EXPER. I.

If the Cake of Roſin be of an Elliptic Form, and the Iron Globe be placed in the Centre of it, the light Body will deſcribe an Elliptical Orbit of the ſame Excentricity as the Form of the Cake.

If the Iron Globe be placed in or near one of the *Focus*'s of the elliptick Cake, the light Body will move much ſwifter in the *Apogee* Part of the Orbit, than in the *Perigee* Part, contrary to what is obſerved of the Planets.

EXPER. II. Take the ſame or ſuch another Iron Globe, and having faſtened it on an Iron Pedeſtal about one Inch high, ſet it on a Table, then ſet round it a Glaſs Hoop or Portion of an hollow Glaſs Cylinder of ſeven or eight Inches Diameter, and two or three Inches high: This Hoop muſt be firſt excited by warming and gently rubbing it, then hold the light Body ſuſpended as in the firſt Experiment, and it will of itſelf move round the Iron Globe from Weſt to Eaſt in a circular Orbit, if the Hoop be circular and the Globe ſtand over the Centre of it, but in an Elliptic Orbit with the ſame Excentricity, if the Globe does not ſtand in the Centre of the Hoop, as in the firſt Experiment, when the Globe does not ſtand on the Centre of the Cake.

[What will happen if the Hoop be Elliptic, he did not mention; I ſuppoſe, he had not an oval Glaſs Hoop by him.]

EXPER. III. This ſame Iron Globe being ſet on the bare Table, without either the Cake of Roſin or Glaſs Hoop, the ſmall light Body being ſuſpended as in Exp. I, II. will make Revolutions round it, but ſlower and nearer to it than when it is placed on a Cake of Roſin, or within a Glaſs-Hoop.

He

He had not yet found that these Experiments would succeed, if the Thread, by which the light Body was suspended, was supported by any other Thing than an human Hand; but he imagined it might happen the same, if the Thread should be supported or fastened to any animal Substance whatever; and he intended to have tried the Foot of a Chicken, a Piece of raw Flesh, or the like. REMARKS.

He imagined to explain the foregoing Particular, by the following odd Phænomenon, of which, he assured me, he was very certain, having often observed it, *viz.* If a man resting his Elbows on his Knees, places his Hands at some small Distance from each other, they will gradually accede to each other, without any Will or Intention of the Man to bring them together; and they will again recede of themselves. In the like manner, the Hand will be attracted by the Body; or the Face of a Man, if he stand near a Wall, will be attracted to the Wall, and be again repelled by it.

He told me, he had thought of these Experiments only a very short Time before his falling sick, that he had not yet tried them with Variety of Bodies, but that from what he had already seen of them, which struck him with new Surprize every Time he repeated them, he hoped, if God would spare his Life but a little longer, he should, from what these Phænomena point out, bring his Electrical Experiments to the greatest Perfection; and he did not doubt but in a short Time to be able to astonish the World with a new Sort of *Planetarium* never before thought of, and that from these Experiments might be established a certain Theory for accounting for the Motions of the Grand *Planetarium* of the Universe.

In trying these Experiments since his Death, I have found that the small light Body will make Revolutions round a Body of various Shapes and Substances, as well as round the Iron Globe, if set on the Cake of Rosin; thus I tried with a Globe of black Marble, a Silver Sand-dish, a small Chip-box, and a large Cork. I observed that the Cake, if nothing stood upon it, would in any Part strongly attract the light Body, as held suspended by the Thread; but when the Globe, or other Body, was set upon it, the Edges of the Cake attracted the strongest, and so gradually the Attraction seemed as it approached the Centre to grow less, till at a certain Distance it was changed into a Repulsion, which proceeded from the Globe, or other Body placed upon the Cake, which very strongly repels the light Body, unless it be held very near it, and then it attracts it strongly. While the light Body is suspended, as in the forgoing Experiments, if you approach the Finger of the other Hand near it, it will fly from the Finger, or be repelled by it with great Vigour.

6. The following Experiments I made in the Autumn of the Year 1732, and repeated them to Mr *Gray* the following Summer, when he came into the Country. I had then Thoughts of communicating them to you through his Hands, to whom they owe their Being, and drew them *Some Electrical Experiments, chiefly regarding the Repulsive Force*

up

of Electrical Bodies; by Granvile Wheler, *Esq; F. R. S.* No. 453. p. 98. April, &c. 1739.

up with a Letter to him prefixed: But, unwilling to be an Author, I deferred the Communication from time to time, till the second Summer came, when I was informed, that Mr *Dufay* had taken Notice of the same Solution of the repulsive Force. All Thoughts of publishing them were then laid aside, but meeting some Time since with a fuller Account of them in the *Memoirs of the Academy of Sciences* for the Year 1735; by which it appeared Mr *Dufay*'s Experiments were not the same with my own, and having since received the Commands of our worthy President to communicate them, I take the Liberty at last of sending them, as I intended they should have passed through Mr *Gray*'s Hands, if Mr *Dufay* had not appeared upon the same Subject, in 3 Propositions, and a few Corollaries.

Otteſden-Place,
Jan. 17, 173$\frac{7}{8}$. GRANV. WHELER.

PROP. I. *Bodies made Electrical, by communicating with an electrical Body excited by Friction, are in a State of Repulsion with regard to such excited Bodies.*

EXPER. I. I hung a fine white Thread by a Loop, to an horizontal blue Silk Line, about four Feet long, tied at each End, and at about a Foot distance from it, placed a Glass Tube two Feet and a half long nearly, and one Inch and quarter Diameter, fixed in the Centre of a circular Piece of Wood supported upon three brass Skrews, so that the Tube and pendulous Thread were parallel to each other. The Tube being rubbed, the Thread was attracted and repelled 7 or 8 times (in very good Weather, I have observed it to move to and from the Tube 12 times, at above one Foot distance). I then tied a Piece of new smooth Packthread to the Top of the Tube, and to the Loop of the Thread hanging down as before, and again excited the Tube: The Thread, without coming once towards the Tube, went into and continued in a State of Repulsion; but if I only touched the communicating Packthread with my Finger, the white Thread immediately hastened to the Tube: And upon hanging another long Piece of Packthread, which reached the Ground, to the communicating Packthread, and again rubbing the Tube, the pendulous white Thread was so far from going into a State of Repulsion, that it became attracted to the Tube, and continued so, without shewing the least Tendency to a State of Repulsion, as long as the Virtue of the Tube lasted.

EXPER. II. I tied a Piece of small Cane about 16 Inches long, and $\frac{1}{4}$ of an Inch Diameter at one End, and a little more at the other, at right Angles to the Top of my Tube, fixed in the same Pedestal as before, and making unequal Arms with it; and at the End of the larger Arm, a Piece of Stick transversly, about 6 Inches long, so as it might slide backwards and forwards to and from the Tube: This moveable short Stick at one End supported a very fine white Thread, at the other a very fine blue Silk, by which

which means we had now a Silk and a Thread at the ſame time hanging parallel to the Tube. The Thread, after the Tube was rubbed, firſt was attracted, but then immediately repelled, and continued a conſiderable Time in a State of Repulſion; but upon tying to the End of the ſhorter Arm of Cane, a Piece of long Packthread, which reached down upon the Table, and rubbing the Tube again, the Thread continued in a State of Attraction, without being once repelled during the whole Virtue of the Tube, as in the preceding Experiment: Yet the Silk, whether the long Packthread was added or not, to the ſhorter Arm of the Cane, continued conſtantly attracted towards the Tube; but upon putting a ſhort Silk only ſix Inches long, in the ſame Circumſtances, it would, after ſome Time rubbing the Tube, turn into a State of Repulſion, the upper Part firſt bending from the Tube, and the lower Part towards it, the upper Bending ſtill increaſing till the whole was repelled; and, which is remarkable, the upper Part or bending, upon the Approach of the Finger, or any Body not impregnated with electrical *Effluvia*, flying towards it, and the under Part or Bending rather ſeeming to fly from it, till the whole was ſaturated, and in a State of Repulſion with regard to the Tube, and then any Part of it would come to the Finger, or any other Body, not made Electrical. It is proper to add here one more Difference remarkable between the Thread and Silk: The Thread in a State of Repulſion touched with the Finger, would immediately fly towards the Tube; but the Silk in the ſame State, after touching ſeveral times, ſtill continued in a State of Repulſion, and would not be attracted till ſqueezed from Top to Bottom between the Finger and Thumb, once, and ſometimes two or three times. And farther, the Thread would immediately turn again into a State of Repulſion, whereas the Silk, after the Violence committed by the Thumb and Finger, being attracted to the Tube, would not without a good deal of rubbing the Tube, be repelled again.

N. B. The Silk was untwiſted, and about $\frac{1}{4}$ Part of the Thickneſs made uſe of.

From the different State of the pendulous Silk and Threads at the ſame time under the ſame Circumſtances, the former being attracted while the latter is repelled, it follows, that a mere Vibration of the Parts of the Tube is not ſufficient to account for the Electrical *Phæno-mena*; which appears farther from the two contrary States continuing ſome time, and from the ſame Piece of Silk being at once Part in a State of Repulſion, Part in a State of Attraction. Corollary I.

That ſome Bodies immediately receive and immediately part with the Electrick *Effluvia*, but that others are ſome time before they receive it, or receive enough of it; and when they have received enough of it, part with it more unwillingly. Corollary II.

That any light Body, as a Feather, after touching or nearly approaching the Tube, muſt fly from it: Upon Contact or a near Approach, it ſaturates itſelf with the Electrick *Effluvia*, and by this means becomes Corollary III.

itſelf

itſelf electrical (as is plain from it's coming to all other Bodies too large to come to it); and conſequently, from the foregoing Experiments, is in a State of Repulſion with regard to the Tube. As ſoon as it touches any other Body, it loſes it's acquired Electricity, and therefore may be attracted as at firſt.

PROP. II. *Two or more Bodies made electrical by communicating with an electrical Body, excited by Friction, are in a State of Repulſion with regard to one another; or Bodies made electrical by Communication, repel one another.*

EXPER. I. I ſuſpended 2 Pieces of white Thread, each about one Foot long, by Loops, upon an horizontal blue Silk Line 4 Feet long, about ½ an Inch aſunder from each other; and upon holding the excited Tube over them at a little Diſtance, the two Threads immediately receded from each other conſiderably at the Bottom. I then removed one of the Threads, and held the Tube over the other, in the ſame manner as before. The ſingle Thread was not obſerved to move to either Side; conſequently the moving of the Threads ſide-ways was occaſioned neither by the Attraction of the croſs Line, nor that of the Tube, nor by the Frame of Wood, to which the croſs Line was tied at each End, but only by their Action upon each other.

I then added a third String, at the ſame Diſtance from the ſecond, that the ſecond was from the firſt, and upon holding the excited Tube over the middle one, at the ſame Diſtance from the croſs Sik I did before, if the Strings continued in the ſame Plane, the middle one ſtood ſtill, and the String on each Side of it receded conſiderably at the bottom Part, which in this Caſe muſt neceſſarily happen upon a Suppoſition, that they repel one another equally; for the 2 contrary Forces of the outer Threads deſtroy each other, and conſequently the middle one muſt remain quiet; but there was nothing to hinder the middle one from repelling the 2 outer on each Hand ſideways. If, as it often happened, the 3 pendulous Threads did not remain in the ſame Plane, they then all receded from one another equally, and formed nearly a triangular Priſm; the 3 Threads being the 3 Edges, or rather a triangular Pyramid with the Top cut off.

Upon ſuſpending four Threads at the ſame Diſtance as before from one another, if they continued in the ſame Plane, they all parted, but the 2 outermoſt more from their Neighbours, than the 2 in the middle from each other.

If they moved out of the Plane they were firſt in, they formed two Priſms, each extreme with the two in the middle forming one, or rather a Parallellopepid, leſs at Top than at Bottom.

When five Strings were ſuſpended, either the middlemoſt continued ſtationary when the Plane was not altered, or if it was, they formed 3 Priſms.

I after-

I afterwards placed two croſs blue Silks, of the ſame Length as before, about half an Inch aſunder from one another horizontally, and tied at each End; and upon each of theſe, at different times, hung 2, 3, 4, and 5 Threads, at the ſame Diſtances as before, when every thing ſucceeded, as it ought to have done, upon a Suppoſition of their mutually repelling one another. Exper. 2.

To each of the Ends of 2 Threads, ſuſpended as at firſt, a Feather being tied, the two Feathers manifeſtly receded from each other: And when 3 Threads had each a Feather at their Extremities, the middlemoſt became ſtationary, and the 2 outer went off on each hand. Exper. 3.

I ſuſpended afterwards 2, 3, 4, and 5 blue ſilk Strings by Loops, upon one croſs blue Silk, and found the ſeveral Experiments ſucceed in the ſame manner as in Threads; except that they remained a longer Time before they appeared in a State of Repulſion, receded from one another more ſlowly, and continued much longer in the repulſive State, after the Tube was removed. Exper. 4.

This done. I made ſeveral Experiments, by mixing Silks of different Colours, and Silks and Threads of different Colours, and ſuſpended them by Turns upon Silks of different Colours, whence aroſe ſeveral different *Phænomena*, which I ſhall not take Notice of here; but I muſt not omit mentioning, that upon ſuſpending two black Silks at the before-mentioned Diſtances from each other, upon a ſcarlet croſs Silk, they did not only open and recede from each other at the Bottom conſiderably, but when the Tube was held under, ran or jumped away from each other, to the very Ends of the croſs red Silk that ſupported them, taking 2, 3, or more Jumps from each other. I obſerved the ſame of two white Silks ſuſpended upon red Silk, but think they did not move away ſo briſkly as the Black. Exper. 5.

I tried whether Threads hanging parallel, as above, from a croſs blue ſilk Line, and joined with one or more tranſverſe Threads, ſo that the perpendicular Threads remained nearly parallel, would mutually repel when the Tube was held over them; they ſeemed to repel each other full as ſtrongly as before. When they were joined by only one croſs Thread towards the Top, the lower Parts ſeparated conſiderably; when joined by 2 croſs Threads, one towards the Top, and one towards the Bottom, they ſeparated both in the middle Parts between the 2 croſs Threads, and at their lower Ends under the ſecond or loweſt croſs Thread. When ſeveral were tied together at the Top and Bottom, and about a Foot long, not by tranſverſe Threads, but in a Knot at each End, they all bellied out from one another, deſcribing a Figure generated by an Ellipſis, revolved about it's greater Axis; approaching nearer to a Sphere, the ſtronger the repulſive Force was. And, though it was only a neceſſary Conſequence, I could not without ſome Pleaſure obſerve the Knot at the Bottom, as the Strings ſwelled out, ſenſibly riſing up. I could ſcarce forbear imagining my Bundle of Silks, a Bundle of muſcular Fibres. Exper. 6.

Exper. 7. I ſuſpended two Braſs and afterwards two Iron Wires upon a croſs blue Silk, in the ſame manner as the Threads and Silks before-mentioned, and found the Experiments ſucceed as in Threads of the ſame Number, except that they did not recede ſo far from one another, which muſt neceſſarily follow from their greater Weight.

N B. Theſe Experiments were made ſometimes with the Tube held over, ſometimes held under the croſs Line; but they generally ſucceeded beſt when the Tube was held under the Extremities of the pendulous Wires, which in this Caſe ſeparated much farther, and kept their repulſive Force much longer.

Exper. 8. I muſt not omit here, that I hung up 2 Fragments of Barometer Tubes, each about a Foot long, by blue ſilk Lines going through each, ſo that they hung parallel, horizontal, at equal Heights, and about $\frac{1}{4}$ of an Inch aſunder; upon holding the excited Tube above and under them, they manifeſtly receded from each other.

I ſuſpended the ſame Fragments of Tubes by blue ſilk Lines of equal Length, from a croſs blue Silk in a perpendicular Poſture, each having a little red Sealing-wax at the upper End, to hinder the Strings from ſlipping off: The excited Tube being brought near them, they receded manifeſtly, eſpecially at the lower Ends; the Diſtance from one another, when at Reſt, being about $\frac{1}{4}$ of an Inch.

Corollary I. From the repulſive State of the Pendulous Threads tied tranſverſly with two or more Threads, and bending out from each other, where at Liberty, it follows that all the Threads of a Table-cloth, or other large Piece of Linen, when made Electrical, (as has been often done all over) have a Deſire to fly from each other; and conſequently, was the repulſive Force ſtrong enough, the whole would be diſſolved, or torn in Pieces. A ſhort Thread of black Silk, by repeated Applications of the Tube, I have ſeparated into it's ſmalleſt Fibres: Whence is ſuggeſted more plainly, than from any other known Experiment, a Reaſon for the Diſſolution of Bodies in their reſpective Menſtruums, *viz.* That the Particles of the Solvend having imbibed the Particles of the Menſtruum, ſo as to be ſaturated with them, the ſaturated Particles become repulſive of each other, ſeparate, and fly to Pieces.

And hence, perhaps, ariſes a Reaſon, why Particles of Bodies ſpecifically heavier than the Menſtruums in which they are diſſolved, are, after the Diſſolution and Diſperſion, ſuſpended all over the Menſtruum, *viz.* That they repel each other. Attraction is inſufficient; for Parts attracted equally in all Directions, are, in Effect, not attracted at all, and the Imperfection of the Fluid will not do; for if this occaſioned the Suſpenſion, ſtriking or joggling the Veſſel would make them ſubſide.

Corollary II. Hence we plainly ſee how Heat may divide the Particles of Water with greater or leſs Force, in Proportion to the Degree of Saturation, and throw them into the Air; where they may continue to aſcend, if at

the ſame time they are divided, they are expanded into little Shells or Bubbles, of a Diameter large enough to be ſpecifically lighter than the lower Air, as the Great *Halley* has ſagaciouſly conjectured. Or if the upper Parts of the Air, as being leſs ſaturated than the lower Parts, may be able to draw them upwards, till the Exceſs of Weight, which is conſtantly increaſing, is equal to the Exceſs of Attraction.

Bodies made Electrical by rubbing, do themſelves repel one another, or the electrical excited Bodies themſelves repel one another. PROPOSITION III.

The two Fragments of Tubes before-mentioned *, being ſuſpended horizontally, and in a Poſture parallel to each other, I held in one Hand, and with the other rubbed ſome time; then gently letting them go ſo as to be at Reſt, I could plainly perceive them recede from each other towards that End which had not been taken hold of. Exper. 1.

But as upon repeated Trials I found it difficult to make this Experiment ſucceed unexceptionably, the Tubes generally having ſome reciprocating Motion of their own, after quitting the Hand I made uſe of the following Method.

I ſuſpended a ſingle little Tube about a Foot long, by a long blue ſilk Line, perpendicularly, and upon a Table placed my great Tube fixed in a Stand as before, excited each alternately, two or three times; then gently moved the Tube with the Stand it was fixed in, near the ſuſpended little one: The little Tube manifeſtly receded ſo much, that a croſs blue ſilk Line ſtretched horizontally at about an Inch Diſtance on the oppoſite Side, would ſometimes, upon the firſt Approach of the great Tube, be touched by it.

Three ſcarlet Silks, pendulous each by Loops from a croſs ſilk Line, and cloſe together, being rubbed downwards two or three times, between the Finger and Thumb, ſhewed a conſiderable repulſive Force with Regard to each other, forming themſelves immediately into a triangular Pyramid and continuing in this State of Separation ſome time, and which ſhews their Attraction at the ſame time, with Regard to other Bodies not excited, coming to them when brought near them. Exper. 2.

I obſerved the ſame repulſve Force in 3 yellow and 3 green Silks, under the ſame Circumſtances, and excited in the ſame manner, but not in ſo great a Degree as in Scarlet. In Blue the repulſive Force was ſcarce diſcernible after ſeveral times rubbing.

The Rev. Dr *Stephen Hales* †, obſerves, "That if a Piece of "one of the *Bronchiæ*, or Gills, of the *Muſcle Shell-Fiſh*, be cut "off, and put into a ſmall concave Glaſs, with 3 or 4 Drops of "it's Liquor, and be then placed under a double Microſcope, "the Blood may be ſeen greatly agitated in the fine Veſſels; and at the "cut Edge of the Piece of Gill, may, with great Pleaſure, be ſeen many *Scholium.*

* Prop. II. Exper. VIII.

† Statical Eſſays Vol. II. Exp. XI. Art 12.

" Blood-Globules, repelled from the cut Orifices of the Blood-Veſſels, " and attracted by other adjoining Veſſels; alſo other Globules rolling " round their Centre, and repelling each other; whence (as he ſays) it " is plain, that Bodies, by briſk rubbing and twirling about, may ac- " quire, in a watery Fluid, both attractive and repulſive Virtue or " Electricity."

From our laſt Experiments we are led to think, that the Globules of the Blood, if by Friction they acquire an electrical attractive Virtue, muſt of neceſſity repel one another; and that Electricity is not ſo properly called an attractive and repulſive Virtue, as a Virtue attractive of thoſe Bodies that are not attractive themſelves, and repulſive of thoſe that are; and that this repulſive Force of the electrical Blood-Globules, excited by Friction, as they flow in their Channels (and particularly in the ſmall ones, and perhaps more ſo in thoſe of the Lungs, where the refrigerating Power of the Air may aſſiſt, as Dr *Hales* has obſerved); this repulſive Force of the Blood Globules, I ſay, may be the great Cauſe that hinders the Blood from coagulating as it circulates; may be the great Cauſe of the conſtant Perſpiration in an healthy State, and of the Increaſe of it, *cæteris paribus*, in Proportion as the Velocity and Friction of the Blood increaſes.

If theſe things are ſo, the Neceſſity of Exerciſe appears more plainly than ever, in order to keep the Body in an healthy State, as we may obſerve here the very Steps that Nature makes uſe of to free herſelf from her Suppreſſions.

An Account of ſome of the Electrical Experiments made by Granvile Wheler, *Eſq*; *at the Royal Society's Houſe*, May 11. 1737. *drawn up by* C. Mortimer, *M. D. R. S. Secr. Ibid.* p. 112.

Exper. 1. 7. A large Octavo Book was placed horizontally upon Silk Lines, and the upper Surface ſtrewed with ſeveral Pieces of leaf Braſs, all or the greateſt Part of which flew upwards, from one another, and off the Book, upon holding an excited Tube at a little Diſtance underneath the Book.

Exper. 2. Two Lines were extended horizontally the whole Length of the Library being between 30 and 40 Feet, diſtant from one another about 2 Feet at one End, and meeting together in a Knot at their other Ends, the whole Lines being Packthread, except 5 Feet of ſilk Line tied at each of the ſeparated Extremities, as well as at the Knot where the other Ends united, in order to ſtop the Current of the *Effluvia*. Upon the united Extremities was placed horizontally a Piece of Card about 2 Inches ſquare, on which were ſtrewed Pieces of leaf Braſs: The excited Tube being held at a little Diſtance under the ſeparated Extremities of the Packthread, the leaf Braſs on the Card at the other End flew upwards, and off the Card.

Exper. 3. Five Glaſs Receivers placed one within another upon an electrical Cement of Bees-wax and *Venice* Turpentine, were all exhauſted: In the innermoſt a fine white Thread about 5 Inches long, was ſuſpended from the Crown of it, by the Aſſiſtance of a little Cement made of Bees-wax and Oil. Upon moving the excited Tube up and down near the Side of, and horizontally to and from, the outward Receiver, the ſuſpended Thread

Thread manifeſtly made many Vibrations correſponding to the Motions of the Tube.

An electrical circular Cake of Bees-wax and Roſin, ten Inches in Diameter, was placed horizontally upon a tall Glaſs Receiver near 3 Feet high, ſuch as is made uſe of for the dropping the Feather and Guinea. This Cake being, the preceding Evening about Eight o'Clock, warmed with an hot Iron held over it, and then ſtruck perpendicularly all over it's Surface with the Hands in parallel Directions, and ſo left covered with a thin Paſteboard, was about 12 next Day at Noon gently uncovered, and an Ivory Ball about 1 ½ Inch Diameter placed in the Centre, a fine white Thread about 10 Inches long, with a ſmall Piece of Cork, the Size of a Pin's Head, at the End of it, being held between the Finger and Thumb, was gently let down upon the Vertex of the Ball; it firſt flew off at ſome Diſtance, and then made ſeveral pretty regular Revolutions from Weſt to Eaſt about it, in the Form of a Circle. Exper. 4.

The Ball was removed, and the Cake again warmed and excited as before; after which the Ball was replaced at a little Diſtance from the Centre, nearer to Mr *Wheler*; the Conſequence of which was, that the pendulous little Body moved with a direct Motion as before, but in an Orbit that reſembled an Ellipſe, having the Ball in one of it's *Foci*. Exper. 5.

Two Bullets fixed on little Stands of Cork about ¼ of an Inch high, were placed upon the Cake, each about an Inch diſtant from the Centre of it, and in a Line with the Centre and Mr *Wheler*; the pendulous Body deſcribed an Orbit reſembling an Ellipſe, having the two Bullets for it's *Foci*, and the Motion was direct from Weſt to Eaſt. Exper. 6.

Inſtead of the Cork, another pendulous Body of a cylindrical Form was made uſe of, tied to a fine white Thread about 20 Inches long; the Cylinder conſiſted of two circular Baſes of Paper ½ an Inch Diameter, but all cut away except a Ring and a ſmall Bar croſs the Middle, through which Baſis 6 equal fine Threads paſſed at equal Diſtances from one another, knotted at the lower Baſe ſeparately, and joined together in one Knot at about ½ an Inch Diſtance from the upper Baſe, from which Knot proceeded the long Thread. This Body moved from Weſt to Eaſt about the central Ball, and at the ſame time diſcovered a Motion about it's own Axis in the ſame Direction; but after two or three Turns generally ſtopt, and turned the contrary Way, which ſeemed to ariſe from the untwiſting of the Thread. Exper. 7.

A Thread about a Foot long, was ſuſpended from a horizontal Line of Packthread, parallel to it an excited Tube placed erect in a Stand, the Thread approached the Tube, and continued in a State of Attraction: A Thread of the ſame Length, ſuſpended from a Silk Line, vibrated backward and forwards 2 or 3 times, being firſt attracted, and then repelled, and continuing ſome time repelled; but upon joining the Top of the Tube, by a Packthread going round it, to the Loop of the Thread, the Thread continued conſtantly in a State of Repulſion, ſhewing no Tendency to Attraction. Exper. 8.

Two

Exper. 9. Two black Silks, about the ſame Length with the Thread in the preceding Experiment, were ſuſpended by Loops from an horizontal red Silk Line, at the Diſtance of about ½ an Inch from each other; upon holding the excited Tube under them, the Silks ſwelled out from one another, and then jumped away on each Hand to the Diſtance of 2 Feet.

Exper. 10. A circular Board of nearly the ſame Diameter with the electric Cake, was ſuſpended horizontally by 6 Silk Lines, tied to one Silk Line which was brought over a Pulley at the Top of a Frame of Wood, ſo as to be moved up and down. From the Board hung 6 fine white Threads about 18 Inches long, fixed by a little Cement at equal Diſtances from each other. The Board being let down till the Ends of the Threads were about an Inch diſtant from the electric Cake, which was directly under, and had the Ivory Ball on it's Centre; the Threads all approached towards the Centre of the Cake, both when the Ball was in the Centre, and when taken away, keeping an equal Diſtance from the Centre, and from one another, as long as a Packthread joined the Circle of Board and the Frame to keep it ſteady; and upon removing the Ball out of the Centre towards the Circumference, the Figure lengthened, the Threads next the Ball advancing nearer the Circumference; when the Ball was placed at about an Inch Diſtance from the Circumference, the Thread that was before neareſt the Circumference, whipped between the Ball and the Centre, ſo as to be almoſt in the ſame Plane with it's two neighbouring Threads, the Figure formed by the Extremities reſembling an Ellipſe with one End cut off: But when inſtead of the Packthread that joined the Board to the Frame, a blue Silk Line was tied in the ſame manner in all reſpects, the Threads, inſtead of coming towards the Centre, all flew away at a great Diſtance from the Cake, and from one another.

It ought to be obſerved in the Experiments of the circular Motion of the pendulous Body, that Mr *Wheler*'s Hand ſeemed as ſteady as poſſible, except in the firſt Experiment, when a litttle Trembling appeared; Mr *George Graham* taking a very good Method to obſerve it, by keeping his Eye fixed upon a Point at a conſiderable Diſtance, in the ſame Line with the End of Mr *Wheler*'s Finger, and his own Eye.

Yet when Mr *Wheler* had finiſhed the Experiments to the Satisfaction of all preſent, Mr *Hawskbee*, Mr *George Graham*, and Dr *Mortimer*, held the Thread with the pendulous Body over the Cake with the Ball on it's Centre, after the Cake had been excited by Mr *Wheler*; but they had no regular Revolutions at all, though ſeveral very manifeſt Motions were made with the Hand, to try if a projectile Motion might by that means be given to the pendulous Body. Mr *Wheler* had tried the ſame thing with his Servant; from whence it is reaſonable to conclude, that it is neceſſary, that the ſame Perſon who excited the Cake ſhould likewiſe hold the Thread; as if there were ſome Analogy between the *Effluvia* excited by the clapping of the Hand on the Cake, and the *Effluvia* which

may

may be communicated along from the Hand which holds the Thread to the Piece of Cork at the End of it. And this ſeems to be the Reaſon of what the late Mr *Gray* told me, *viz.* That there was ſomething in the human Hand eſſential to the Experiment, which he had not yet found in any other Supporter of the Thread.

Some Remarks on the late Mr Gray's *Electrical Circular Experiment, by* Granvile Wheler, *Eſq; Ibid. p.* 118. *dated* Feb. 20. 1737-8.

8. Some odd Circumſtances led me to make Mr *Gray*'s circular Experiment in the following Manner. While I excited a Cake of Roſin and Bees-wax 10 Inches Diameter, by clapping with my Hand, I let my Ivory Ball continue in a Baſin of Water; then ſhaking off the Drops, placed it in the Centre, and with my right Hand held a fine Thread, about 8 or 9 Inches long, having one End rolled up into a little Ball, and the other, for about an Inch, reduced to it's greateſt Fineneſs, to only one Fibre, myſelf and Hand being ſupported on the Back of a Chair. The Succeſs was, I had a great many Revolutions, to the Number of 50, from Weſt to Eaſt; but at firſt not ſo regular as towards the laſt, at firſt deſcribing only about $\frac{1}{3}$ of the Circumference at a Time, and after ſtanding ſtill a little, deſcribing another third Part. I might probably have had a great many more Revolutions, but being tired, I was forced to reſt myſelf, which I did for 10′, then took up the Thread again. The Thread ſtood repelled at ſome Diſtance, without making any Revolutions, and at laſt only made half an one the contrary way to what it did before; but upon wetting it, by drawing it 2 or 3 times over the Surface of the Water, it made again 20 more Revolutions from Weſt to Eaſt, only at a ſmaller Diſtance from the Ball, (for the Water muſt make it heavier) but full as regular as before, and rather quicker: The Virtue of the Cake muſt now have laſted about three quarters of an Hour. After reſting about 6′, I tried again with the String freſh wetted, the Ball and Cake continuing as before; and had, to my great Surpize, 100 Revolutions in the Space of about 12′, the Revolutions being ſtill quicker, and more regular, and nearer the Ball; and at the ſixth Revolution of this laſt Hundred, the Thread was attracted to the Surface of the Ball, and, being wet, did not diſengage itſelf, till pulled away; yet after this, deſcribed the remaining Ninety-four Revolutions of the Hundred, and ſeemed inclined to deſcribe a great many more, but that I was forced to reſt my Arm again, which I did for about 8′, then tried again, the Thread being freſh wetted, and had 70 Revolutions at nearly the ſame Diſtance from the Ball in leſs than 9′, all very regular, and without any Attraction of the Thread to the Ball. I reſted again 16′, wet the Thread again, and held it as uſual; it was repelled at about $\frac{1}{2}$ Inch Diſtance from the Ball, but ſeemed to have no Tendency to a circular Motion; yet after continuing ſtationary about 1′, I perceived a Motion about it's Axis, about which it took ſeveral Turns; but ſtill had little or no progreſſive Motion, till about 1′ longer, when it began to move forward, and continued doing ſo from Weſt to Eaſt, for about 33 Revolutions, very regular, but ſlower than in the 2 laſt Caſes, the String having been held about 10′, and the Revolutions

performed

performed in about 7 or 8 of them. I obſerved each of theſe 3 laſt times, it was rather longer before the progreſſive Motion began than uſual; and in all the Trials of this Experiment, I frequently perceived a Motion about the Axis, which was generally from Weſt to Eaſt, though now-and-then the contrary Way. The Virtue of the Cake muſt now have laſted near 2^h; about $\frac{1}{4}$ of an Hour after, I tried again, and had 60 Revolutions from Weſt to Eaſt, in about $10'$, the Diſtance from the Ball being ſtill leſs than before, hardly $\frac{1}{4}$ of an Inch, ſcarce any Revolution about the Axis appeared, and at the Beginning the Thread was twice attracted to the Ball. About an Hour and half after, the Virtue of the Ball was not quite gone, the wet Thread being repelled, and making 3 or 4 Revolutions from Weſt to Eaſt, as well as moving a little about it's Axis the ſame Way. But as it was reaſonable to ſuppoſe the Ball itſelf in the Centre of the Cake was now dry, with a Feather dipped in Water I wet it's Surface; yet found no Increaſe of Virtue, rather a Diminution of it, the pendulous Body ſeeming ſcarce at all repelled; but it is to be obſerved, that the Ball, as it was wetting, twice tumbled over, and rolled upon the Surface of the Cake; by which means the Virtue of the Cake might be much diminiſhed.

It is not improper too to take Notice here, that during the Revolutions of the wet String, I have frequently obſerved a kind of Oſcillatory Motion, as if there was an alternate Intention and Remiſſion of the repulſive Force. As alſo that I have often taken Notice of little Plucks, and convulſive Motions, in the pendulous Body, and ſometimes thought I have felt ſomething like it in my Arm that held it, though at no other time have I ever been ſenſible of any ſuch thing.

I have ſeveral times ſince repeated this Experiment with the Thread and Ball both wet, and found it ſucceed much better than when they were both dry; and once I find by my Notes, I had two hundred and twenty Revolutions before I reſted my Arm. I have tried too with the Ball dry, and the String only made wet; but the Virtue did not continue ſo long, as when both were wet.

I now flattered myſelf with Hopes of Succeſs, if the Thread was ſuſpended from an undoubted fixed Point, which therefore I proceeded again to try with the greateſt Care and Caution, but in vain; the Revolutions were uncertain.

This Difference naturally led me to reflect upon the Cauſe of it. The Tremor of the Hand would not account for it; for this being both ways backward as well as forward, muſt as often hinder as promote a continual Motion one way: And though in two oppoſite Parts of a Circle, the Motion is really in contrary Directions, and therefore the contrary Impulſes of a Tremor may promote a Revolution applied at oppoſite Places of the Orbit; yet as theſe Tremors are irregular, and ſucceed much quicker than the Revolutions are performed, they ſeem inſufficient to account for the Motions of the pendulous Body, performed with any Degree of Regularity.

A Stream

A Stream of Air in my Room might impel along the Tangent the pendulous Body, kept at a Diſtance from the Ball by it's repulſive Force; and then Gravity, taking place, might with the firſt Motion compound a Curve; but ſtill the Reſiſtance of the Air would ſoon deſtroy the original Impulſe, could a few Revolutions be performed; and beſides, one Revolution could not be performed, becauſe the ſame Stream of Air that began the Motion, muſt be contrary to it in it's Return.

A Finger held on the right Hand near the pendulous Body, when ſuſpended from a fixed Point, will make it revolve from Weſt to Eaſt; but then it muſt be applied and removed alternately: The repulſive Force therefore which the Arm may acquire, by being held in the Sphere of the *Effluvia*, is inſufficient; for, as it is in one Place, it muſt impel only one way, and conſtantly the ſame way; and therefore, like a Stream of Air in the Room, though it might create the Beginning, it muſt hinder the Completion of a Revolution.

Sometimes I have doubted, whether the Pulſe of the Arm might not be aſſiſting in giving a projectile Motion. When one Leg is laid over the Knee of the other, a Motion and Heaving of the Leg that lies over, anſwering to every Stroke of the Pulſe, is very apparent at a Diſtance: The Arm therefore in ſome Poſtures, in which it's great Artery meets with a proportionable Preſſure or Reſiſtance, may have a conſtant Motion, though leſs perceivable.

What ſeemed the moſt probable Solution, was this: When the Arm is extended, the Poſture being uneaſy, there muſt be a Reaction of the Muſcles, or a continual pulling of the Arm towards the Body. When therefore the right Arm is made uſe of, the pulling will be from Right to Left; and conſequently the Motion produced in the Body held by it in the ſame Direction, or from Weſt to Eaſt. When the left Arm is made uſe of, the Reaction of the Muſcles will be from Left to Right, and therefore the Motion of the pendulous Body from Eaſt to Weſt. And, agreeably to this, I have obſerved, (as I formerly took Notice, though this Reaſon did not then occur to me) when I uſed my left Hand, all other Circumſtances continuing the ſame, the Motion of the pendulous Body was from Left to Right, or from Eaſt to Weſt, contrary to what was obſerved when held by the right Hand.

Yet ſtill neither of theſe Solutions would account for the Variety of Oddneſſes I have met with under various Circumſtances.

I proceeded therefore to try with Reſts for my Arm of different Heights, having an Arm of Wood, about 2 Feet long, fixed to a Reſt for my Teleſcopes, which I could raiſe to any Height I wanted; and I found the Experiment ſucceed only well, when the Reſt was lower than the electric *Area*, and the Arm was ſupported upon it's Elbow, which was the Poſture conſtantly made uſe of, when reſted upon a Chair, the Chair being lower than the electric *Area*, that it might leſs affect the *Effluvia*, as was then thought.

I began now to think with myſelf, whether it was not poſſible, that an Inclination to a Motion one way in the Perſon that holds the Body, might not have ſuch an Influence upon the Arm, and conſequently the String and pendulous Body, as to determine them the ſame way by ſome Preſſure or Byaſs put upon it, though no Motion ſenſible even to himſelf, was produced in the Hand. If ſo, I might, by a contrary Inclination, produce a Motion the contrary way. Having therefore a fine Day, and my circular Cake being well excited, I tried if I could not produce a regular Motion from Eaſt to Weſt, about the Ball in the Centre, having my Hand ſupported, as uſual, upon the Back of a Chair. I found I could produce a very regular one from Eaſt to Weſt for many Revolutions, and change from one Motion to another, without being ſenſible I moved my Hand at all.

I then wet the Ball and String, as in the Experiment before-mentioned, and found I could tire myſelf with a Motion either from Eaſt to Weſt, or from Weſt to Eaſt, as I pleaſed, without giving any Motion, that I could perceive, to my Hand or Fingers. Hence many odd Experiments that pleaſe, may, when repeated, ſucceed.

Since therefore the Motion of the pendulous Body from a Point undoubtedly fixed, is irregular, as I have found by many different Experiments, repeated with the greateſt Care and Caution; and ſince I am convinced from theſe laſt-mentioned Trials, the Motion from Weſt to Eaſt, and from Eaſt to Weſt, muſt generally have been determined by myſelf; I am inclined to think, that a Deſire of producing a Motion from Weſt to Eaſt, was the ſecret Cauſe that determined the pendulous Body to that Direction, by ſome Impreſſion from Mr *Gray*'s Hand, as well as my own, though I am perſuaded at the ſame time, he was not ſenſible of giving any Motion to his Hand himſelf: And I the rather think this was the Caſe, from the Inſtance Mr *Gray* gives, by way of Explanation, of a Man reſting his Elbows upon his Knees, this implying that he reſted his Arm upon his Elbow, as I did myſelf.

But though upon the whole it does at laſt appear, that this Motion from Weſt to Eaſt in a pendulous Body, applied to another in the Centre of an electric *Area*, is to be aſcribed to the Hand that holds it, and not ſolely to the Nature of the electric *Effluvia*, or the Figure of the central Body; yet ſtill, perhaps, it may not be improper for Aſtronomers to conſider, whether or no a Medium with this Property, that all Bodies immerſed in it, are repulſive of one another, ought not to be joined with Gravity to explain the heavenly *Phænomena*; eſpecially ſince the *Phænomena* of Fire, and our electric *Effluvia*, have a great Affinity to each other; and ſince many of the heavenly *Phænomena* are to be accounted for, upon this Suppoſition, with great Simplicity; and ſome of them, that have not yet perhaps been fully accounted for, ſeem neceſſarily to follow.

Some Thoughts and Experi-

9. The *Phænomena* of Electricity are ſo odd, that though we have a great many Experiments upon that Subject; we have not yet been able from

from their Compariſon to ſettle ſuch a Theory as to lead us to the Cauſe of that Property of Bodies, or even to judge of all it's Effects, or find out what uſeful Influence Electricity has in Nature: Though certainly, from what we have ſeen of it, we may conjecture, that it muſt be of great Uſe, becauſe it is ſo extenſive.

ments concerning the Electricity, by J. T. Deſaguliers, *LL.D. F.R.S.* No 454. p. 186. July, *&c.* 1739.

Though ſome Perſons have been too haſty in their Conjectures, and too apt to run into Hypotheſes not ſufficiently ſupported by Experiments, yet it would be of great Uſe to ſettle ſome general Propoſitions concerning Electricity from the Light we have already, and what we may further diſcover by future Experiments; provided we have a ſufficient Number of them to ſettle a general Rule. For Example; I now propoſe ſome general Aſſertions to be conſidered, and to be rejected or allowed of as a Number of Experiments ſhall determine; but to ſtand only as *Queries* till they are ſettled.

I have hitherto avoided entertaining the *Society* upon this Subject, or purſuing it ſo far as I might have done, (conſidering that I can excite as ſtrong an Electricity in Glaſs, by rubbing it with my Hand, as any body can) becauſe I was unwilling to interfere with the late Mr *Stephen Gray*, who had wholly turned his Thoughts that Way; but was of a Temper to give it entirely over, if he imagined, that any Thing was done in Oppoſition to him. But now I intend not only to go on myſelf in making electrical Experiments, but ſhall always be ready to make ſuch as ſhall be propoſed by any Member of the *Society*. The *Queries* which I have already examined, are the following:

Whether all Bodies in general are not capable of receiving the Electricity which has been given to a Tube by Friction, though there be a great many Bodies, ſuch as Metals and Vegetables, *&c.* in which we have not hitherto been able to excite any Electricity by Heat, or Friction, or any other Operation on the Bodies themſelves? Query 1.

Whether when a String is ſtretched out at Length, with a Body hanging at one End of it, to which Body we would communicate the Electricity of the Tube rubbed at the other End, the Supporters of the String ought not to be of ſuch Bodies as are capable of having Electricity excited in them by Friction, Heating, Beating, or Patting, or ſome immediate Operation on the Bodies themſelves? Query 2.

Whether theſe Supporters of the String (mentioned in the laſt *Query*) which ſtops the electrical Virtue from paſſing any farther, are not of ſuch a Kind as are incapable of having the electrical Virtue excited in them immediately by any Operation yet known; though they are all capable of receiving it from a rubbed Tube, even at a great Diſtance, by the Communication of a String made of vegetable Subſtances? Query 3.

Whether the Reaſon, that ſome Supporters tranſmit the Electricity running from the rubbed Tube along the String to Bodies beyond them, be not as follows, *viz.* That having received ſome of the electrical Stream, they ſoon become ſaturated with it, and ſo receiving no more of it, let the reſt paſs on without diſturbing it? Query 4.

Query 5. Whether the Reaſon, that Supporters, made of vegetable Subſtances, Metals, and ſuch others, as ſtop the Electricity above-mentioned from running any farther along the String than the Place where it reſts upon them, be not this? *viz.* That they are never ſaturated with the electrical Stream, but continually receive it, and tranſmit it to the next contiguous Body, provided that contiguous Body be of the ſame Kind with themſelves, and alſo contiguous to other Bodies of the ſame Sort: I mean ſuch as would ſtop the Electricity, if the String was ſupported by them. For even theſe Supporters will tranſmit the Electricity, if terminated at each End by Bodies that tranſmit the Electricity, when they ſupport the String.

Query 6. Whether we may not diſtinguiſh all Bodies in general, in reſpect of Electricity, into ſuch as may be excited to Electricity, and ſuch as cannot be excited to Electricity? The two Kind of Bodies receiving the Electricity from other Bodies into which it has been excited differently; the firſt alſo tranſmitting the Electricity, while the others do not.

Theſe *Queries* are ſuch as ariſe from a Conſideration of Experiments made by others, and ſuch as I have made myſelf.

As I go on in making other Experiments, other *Queries* may ariſe, and I ſhall communicate them.

Here follow the Experiments I have already made, and am ready to repeat as the *Society* may deſire.

Experiments relating to Query 1. I ſtretched a Cat-gut about 5 Feet in Length, and faſtened it to the Top of 2 Chairs in an horizontal Situation, and ſuch another Cat-gut String to 2 other Chairs parallel to the firſt, and at the Diſtance of 15 or 20 Feet from the former. Then I ſuſpended one End of a Packthread to the Middle of the firſt Cat-gut, and carried it on ſo as to lay it over the Middle of the other Cat-gut, and leave the other End of the Packthread hanging down about a Foot below the Cat-gut, with a Loop to hang ſeveral Bodies to it, ſucceſſively to receive the Electricity excited by the Tub, and applied to the other End of the Packthread.

All the Bodies I tried received the Electricity communicated from the rubbed Tube along the String, which appeared by holding a Thread faſtened to a Stick, the Thread being attracted towards the ſuſpended Body.

1. A Gold Medal. 2. A Silver Medal. 3. A Copper Medal. 4. A Braſs Ball. 5. A Steel Ball. 6. A Tin Ball. 7. A Leaden Ball. 8. Sulphur. 9. Sealing-Wax. 10. Pumice-Stone. 11. Bees-Wax. 12. Reſin. 13. *Sal Ammoniac.* 14. Ivory. 15. Human Bone. 16. Fiſh-Skin. 17. Load-ſtone. 18. Fleſh. 19. Cotton. 20. Wax-Candle. 21. Tallow-Candle. 22. A Leak. 23. Celeri. 24. Tobacco-Pipe. 25. A Glaſs Ball. 26. A Ruſh rolled up.

Experiments relating to Query 2. Retaining the firſt ſupporting String of Cat-gut, inſtead of the laſt Cat-gut Supporter, I made the Packthread paſs over the following Subſtances ſucceſſively, all which tranſmitted the Electricity to the Body ſuſpended at the End of the Packthread; *viz.* 1. A Silk String. 2. Hair

2. Hair Rope. 3. Parchment. 4. A Thong of Sheep-ſkin, but it ſtopped the Electricity till it was dry and warm. 5. A Liſt of Woollen Cloth. 6. A Liſt of Flanel. 7. Cadis, or a Kind of Worſted Tape. 8. Quills. 9. Whalebone. 10. A Man's Thigh-Bone. 11. A Bladder. 12. A Cat, held between two. 13. A Tallow-Candle. 14. A Wax-Candle (the String was alſo laid over the unburned Cotton Wick at the End of the Candle). 15. A Tallow-Candle and it's Wick. 16. Tobacco-Pipe, with a Cat-gut or a Packthread through it, or without, that is, a Packthread String being faſtened at each End of it. 17. A Sword-Belt. 18. A Piece of a white Hat. 19. A Piece of a black Hat. 20. A Glaſs Tube. 21. The ſame with Water in it. 22. With Spirit of Wine. 23. The ſame with Mercury in it. 24. Sealing-Wax. 25. Crape.

N. B. All theſe Subſtances, except the Sheep-ſkin, the Tobacco-Pipe, the Quills, the Candles, and the Bone, not only tranſmitted the Electricity, but became ſo far electrical, as to attract the Thread a little Way on each Side of the ſupported Packthread.

There are more Experiments required to be made, before this *Query* can be turned into an Aſſertion.

Experiments relating to Query 3.

Inſtead of the laſt Supporter of Cat-gut near the ſuſpended Body, I made uſe of the following Subſtances ſtretched from Chair to Chair; and then the Thread hanging on the Stick was not at all attracted by the ſuſpended Ivory Ball, which I made uſe of in all the Experiments to try the Supporters.

1. A Hempen Rope. 2. A ſmall Packthread. 3. A drawn Sword. 4. A Sword in the Scabbard. 5. The Scabbard without the Sword. 6. A twiſted Cotton Thread. 7. Tape made of Thread. 8. Bars, Tubes, and Wires of Copper, Braſs, Iron, and Lead. 9. White Paper and brown. 10. A moiſt Thong of Sheep ſkin. 11. Celeri. 12. Leeks. 13. Fir-wood. 14. A Cane. 15. A Piece of black Thorn. 16. The ſame Ruſhes that had before received the Electricity when ſuſpended. 17. A Spunge dry. 18. White Thread. 19. Hay. 20. A Marble Slab.

N. B. Such Bodies as were too ſhort to reach from Chair to Chair, were lengthened out by Pieces of Packthread at each End.

Experiments relating to Query 4.

The Cat-gut Supporters, and all the others mentioned in the Experiments to *Query* 3, which tranſmitted the Electricity, attracted the Thread of the Stick near the conducting Packthread, but not ſo far as the Chairs to which the ſaid Supporters were faſtened.

Experiments relating to Query 5.

All the Supporters which did not tranſmit the Electricity, when they reached from Chair to Chair, were made to tranſmit, when they were lengthened out with Cat-gut at each End, and then they became electri-

cal.

cal themſelves from one End to the other, as becoming Part of the ſuſpended Body; and becoming ſo ſaturated, as not to be able to carry the Electricity on either Side any farther than the Cat-gut to which they were faſtened.

Experiments relating to Query 6.

The late Mr *Stephen Gray* has, by rubbing, excited Electricity in ſeveral of thoſe Bodies which I have made Supporters of to tranſmit the Electricity: I have done the ſame with ſeveral others, but not with all of them, though I ſhall try them all: But as it is more difficult to excite that Virtue in ſome than others, and all the Experiments in general ſucceed better in dry and cold Weather than in moiſt and warm, I muſt wait for proper Opportunities to make the Experiments, and then I ſhall communicate them.

Experiments concerning mixed Subſtances.

1. Cadis (or Woollen Tape) laid on Thread-Tape, when made a Supporter, tranſmitted the Electricity.

2. When the Thread-Tape was uppermoſt, the Electricity was ſtopped.

3. When they were twiſted together, the Electricity was tranſmitted, but moſt weakly when the Packthread going to the Ball was laid over that Part of the Twiſt which had the Thread-Tape.

N. B. The two Paper Supporters which did not tranſmit the Electricity, ought to have done it according to *Query* 2, becauſe, by Mr *Gray*'s Experiments, Electricity is to be excited in the Paper by rubbing: Therefore, perhaps, the Papers wanted to be drier or warmer, ſo that I ſhall try them again. Theſe are the only two Experiments that do not agree with the ſecond *Query*; but I would not omit mentioning them, becauſe it is the Part of an impartial Philoſopher to mention as well thoſe Things which favour, as thoſe that diſagree with his Hypotheſes and Conjectures.

Experiments made before the Royal Society, *Feb.* 2, 1737-8, *by the ſame.* *Ibid.* p. 193.

10. *N. B.* In the following Account, which is the Sequel of former Experiments, I call *Conductors* thoſe Strings, to one End of which the rubbed Tube is applied; and *Supporters* ſuch horizontal Bodies as the *Conductor* reſts upon.

Experiment 1. Old Packthread Supporters tranſmitted Electricity but weakly, though more ſtrongly when twiſted with Cat-gut; but new Packthread did better.

N. B. *Where it is not mentioned otherwiſe, an Ivory Ball hangs at the End of the* Conductor; *and it's Electricity is tried by a Thread applied near it.*

Experiment 2. A Conducting String of Cat-gut received the Electricity a little Way; but did not carry it quite to the Tube.

Two

Two conducting Strings, one of Cat-gut, and one of Packthread, compared, the first attracted less and less, as the Distance from the Tube increased; and the other more and more, till it was strongest at the suspended Body: But both ceased immediately after the Removal of the Tube. Exper. 3.

A Sealing-Wax Supporter transmitted the Electricity, but did receive little or none when suspended. If it was but just rubbed with the Hand, it attracted the Thread when first suspended; and strongly, if much rubbed; but that Virtue was soon lost, if the Tube was applyed to the conducting String, and then it would receive no more Electricity from the Tube. If the Stick of Wax was wet, then it would strongly receive the Electricity. Exper. 4.

A Wax Supporter wet, and Silk String wet, did not transmit the Electricity.

Dried Ox-Guts did not transmit Electricity when held in Hand; but when tied to Cat-gut, transmitted it; and, when suspended, received it plentifully. Exper. 5.

The same with a small Cord. Exper. 6.

The same with a Rod of Iron, and Tube of Brass. Exper. 7.

A Glass Tube, made Conductor, received the Electricity but a little way. Exper. 8.

Dry Sheep-Skin transmitted the Electricity, but not when wet, though it received it then when suspended. Exper. 9.

A middle Supporter of Packthread was again supported on one Side by a Glass Tube, and on the other by Sealing-Wax, and had at each End an Ivory Ball hanging. Those Balls became electrical in the same manner, and at the same time, as the Ball at the End of the conducting String. Exper. 10.

When a Bar of Oak was made use of instead of the Tube, or a small Iron Bar instead of the Wax, the Electricity was stopped: But if the Bar was thrust a little way into a Glass Tube, the Electricity was communicated as before. Exper. 11.

11. I fixed 6 Iron *Radii* of twisted Iron Wire to a Brass Ring of two Foot and an half Diameter, and half an Inch wide, which had a Socket in the Centre, whereby to set it either on an upright Glass Tube, or on a wooden Pillar: Then I hung upon the End of the six *Radii*, next to the Circumference, the following Substances. 1. A Piece of Resin. 2. A Stick of Wax. 3. An Apple. 4. An Ivory Ball. 5. A Steel Ball. 6. A Glass Ball. *Experiments made at the* Royal Society, Feb. 9. 1738. *by the same.* *Ibid.* p. 196.

I rubbed the Tube, and applied it to the Centre of this Machine, as it stood on a Glass Tube; and the Electricity was communicated to all the suspended Bodies, and the Ring also; but none of them received it, when the Machine stood upon a wooden Pillar, whose Foot was on the Floor. Exper. 1. *and* 2.

I tied to the Ends of the 6 *Radii* as many Cat-gut Strings, but so long as to unite together about a Foot higher than the Centre of the Ring, Exper. 3.

where I ſuſpended them by another Cat-gut String 3 Foot long, the Top of which was faſtened to an hempen Rope. Then applying the rubbed Tube very near the Place where all the Cat-gut Strings joined over the Ring, (at which Ring the ſame Bodies were ſuſpended as before) neither the Bodies nor Ring received any Electricity.

N. B. This was done in foul Weather, when the Electricity does not extend itſelf far from the Tube: But in fair Weather, the Electrical Virtue, at the ſame Diſtance, reached the Iron *Radii* of the Ring; and conſequently the Ring and Bodies ſuſpended, though the Virtue was not propagated along the Cat-gut: For if the Tube was applied a little higher to the ſingle Cat-gut, ſo as the *Effluvia*, or Virtue darted directly from the Tube, did not reach the Ring, or it's Iron *Radii*, then no Virtue was communicated to the Ring, or the ſuſpended Bodies, *&c.*

Exper. 4. I ſuſpended the Ring by ſix Packthreads, juſt in the ſame manner as the Cat-gut Strings before; but ſtill all thoſe Strings were ſuſpended by the perpendicular Cat-gut of three Foot in Length. Then all the Bodies received the Electricity from the rubbed Tube applied to the Top of the Pyramid of Packthreads.

Exper. 5. Inſtead of the perpendicular Cat-gut between the Pyramid of Packthread and the upper hempen String, I ſubſtituted a Packthread; and then no Virtue was communicated to the Ring, but all went up the hempen String, and was loſt; except the Tube was held very near the Ring, and then it gave a ſmall Degree of electrical Attraction to the Ring, and the Bodies ſuſpended at it.

Exper. 6. Having again ſuſpended the Ring with the Bodies and Pyramid of Packthreads to the perpendicular Cat-gut, I tied a Packthread to the Ring, and carried it horizontally about 20 Feet from the Ring; and having faſtened a Cat-gut String three Foot long to it, I gave it an Aſſiſtant to hold: Then applying the rubbed Tube to the End joining that Cat-gut, the Electricity was communicated to the Ring, and all the ſuſpended Bodies, as appeared by applying the white Thread near them, which was attracted by every Part of the Ring, and all the Bodies.

Experiments made before the Royal Society, Feb. 16. $173\frac{7}{8}$. *by the ſame.* *Ibid.* p. 198.

12. I applied the rubbed Tube to a burning Candle, and it had no manner of Effect on the Flame; but as ſoon as the Candle was blown out, it attracted the Smoak at four or five Inches Diſtance.

Exper. 1. An horizontal Packthread, of about 18 Feet in Length, being terminated by the Cat-gut Strings, of three Foot long each, I hung (towards one of the Ends of the Packthread) upon it a Candleſtick with a lighted Candle in it; then applying the rubbed Tube to the other End of the Packthread, the Candleſtick attracted the Thread, and it was alſo attracted by the Candle, but not within 2 or 3 Inches of the Flame; but as ſoon as the Candle was blown out, the Thread was attracted by every Part of it; nay, even the Wick, when it was quite extinguiſhed.

Exper. 2.

I ſuſ-

I ſuſpended a Wax Candle in the ſame manner, and the Experiment ſucceeded in the ſame manner; only the Electricity came not ſo near the Flame in the Wax as in the Tallow Candle. Exper. 3.

I hung an Iron Wire 16 Foot long horizontally by two Cat-gut Strings at it's Ends about 3 Foot long each, and bent down the Wire from the Place joined to the Cat-gut, ſo as to hang down a Foot at one End; then applying the rubbed Tube at the other End, this Conductor carried the Electricity along to the Ball; but not ſo well as the Packthread Conductor; but it did ſomething better when it was wet. Exper. 4.

The ſame happened when the Conductor was Braſs Wire of the ſame Length.

N. B. The Packthread Conductor alſo carried the *Effluvia* ſtronger when it was wet.

13. I took the Glaſs Tube A B of 2 Inches Diameter, which had at one End A, a Braſs Ferril with a Brim cemented to it, and at the other End B, a Braſs Cap cloſe at Top, the Braſs-work being joined to it, in order to exhauſt it of it's Air upon Occaſion. When this Tube was very dry, it would become electrical by rubbing, ſo as to ſnap by paſſing the Ends of the Fingers near it; but that Virtue could not be excited in the Tube nearer the Braſs at the Ends than from *a* to *b*, and not unleſs the Tube was very dry within. *An Account of ſome Electrical Experiments made before the Royal Society*, Feb. 16. 173⅞. *by the ſame. Ibid.* p. 200. Exper. 1.

The Tube being thus prepared, and having an Ivory Ball C, of about two Inches Diameter, tied to it at the End B by a ſhort String, I paſſed the Tube through the horizontally ſuſpended Plate D D, till it was ſtopped by the Brim at A; and as it hung perpendicularly, the Ball C was within a Foot and an half of the Floor. The Plate D D was about 10 Inches in Diameter, and ſuſpended by three ſmall Cat-gut Strings as E, *e*, of about two Feet in Length, all which were tied together at E, to an hempen String hanging from the Cieling at F. Fig. 2.

By reaſon of the Diſtance of the Ends of the Cat-gut Strings cloſe to the Plate at *e e e*, I was able to thruſt in between them one End of an open Tube G G, after I had rubbed it ſo as to make it electrical, to ſee whether I could make the aforeſaid ſuſpended Tube A B the Conductor of Electricity to the Ball C; but the firſt Trial was in vain.

Then laying horizontally over the Plate D D an Iron Bar a quarter of an Inch thick, and a Yard long, I hung at the Ends of it two Ivory Balls *c c*, of the ſame Size as C, by Packthreads of the ſame Length as the Tube A B. Exper. 2.

Having again made the Tube G G electrical, I applied it over A, as before, and immediately the two Balls *c c* received the Electricity, ſo as to attract the *Thread of Trial* T hanging at the End of the Stick S T, when applied near them; though it received no Motion when applied to C. But if the Strings H *c*, inſtead of Packthread, were Cat-gut,

then the Balls *c c* received no Electricity from the Tube G G rubbed and applied over A.

N. B. To be ſure that the rubbed Tube is made electrical, I paſs my Fingers near it after rubbing, to hear whether it ſnaps; but always rub again before I apply it; becauſe by ſnapping it loſes it's Electricity at the Place where it ſnaps.

Exper. 3. When I rubbed the Tube A B, it would then attract the Thread of Trial T between *a* and *b*; but not at all above *a* or below *b*, unleſs when I applied the Tube G G above A: Then the Thread of Trial would be attracted by the Plate D D, and the Top of the great Tube from A to *a*, but no lower. It would alſo be attracted by all the Bar H H, and only three or four Inches below H.

Exper. 4. Having filled the Tube A B with Water, the Electricity of the rubbed Tube G G, applied at A, ran ſtrongly down the Tube A B, and impregnated the Ball C, ſo as to make it ſtrongly attract the Thread of Trial, whilſt the Balls *c c* received no Virtue at all. But upon wetting the Cat-gut Strings H *c* with a Spunge, all the three Balls *c* C and *c* ſtrongly received the electrical Virtue.

Exper. 5. I took away the Bar H H, and it's Balls and Strings; and having well dried the Tube, I rubbed it, and hung it up as before; ſo that it would ſnap, or attract the Thread from *a* to *b*, but no-where elſe.

Then putting the ſmall Bar H H into the Middle of the Tube A B in it's Axis repreſented by the pricked Line, upon Application of the rubbed Tube G G at A, the Virtue was immediately communicated to the Ball C. The ſame thing happened, when, inſtead of the Bar, a Braſs Wire, a Walking-Cane, a ſmall green Stick, or ſmall Packthread was placed in the Axis of the Tube.

Exper. 6. I took a Barometer Tube empty, and very dry, and placed it in the Axis of the great Tube A B; but it would conduct no Electricity to the Ball C; though it carried it down very readily when full of Water, though quite dry on the Outſide.

Another ſmall Tube open at both Ends, which conducted no Virtue to C when dry, being only moiſtened a little by the Breath in blowing through it, carried down the Virtue from A to C very ſtrongly.

N. B. All this while the Cat-gut Strings E *e* received no electrical Virtue.

As I deſign to purſue theſe Inquiries much further, I beg Leave to be allowed to make uſe of ſome Terms, (which I ſhall here define) in order to ſave uſing many Words in giving an Account of ſome electrical Experiments, which I have made, and ſhall hereafter make.

Definition I. A Body *electrical per ſe* is ſuch a Body in which one may excite Electricity by Rubbing, Patting, Hammering, Melting, Warming or

or any other Action on the Body itſelf, as Amber, Sealing-Wax, Glaſs, Reſin, Sulphur, &c. beſides many, if not all, animal Subſtances.

A *Non-electrical* is ſuch a Body as cannot be made electrical by any Action upon the Body itſelf immediately; though it is capable of receiving that Virtue from an *Electrical per ſe*. Definition II.

1. When the Air is full of moiſt Vapours, *Electricals per ſe* are excited to Electricity with very great Difficulty, requiring to be often warmed, and much rubbed; as appears in exciting that Virtue in Glaſs, Amber, Wax, &c. Obſervations.

2. In dry Weather, eſpecially in froſty Weather, the *Electricals per ſe* will have their Virtue excited with very little Action upon them; as appears by warming a Glaſs Receiver, which, without any rubbing, will cauſe the Threads of a Down Feather, tied to an upright Skewer, to extend themſelves as ſoon as it is put over the Feather. Sometimes Reſin and Wax exert their Electricity by only being expoſed to the open Air.

3. *Electricals per ſe* retain the Virtue longeſt when kept near to, or incloſed by, other *Electricals per ſe*. Thus the rubbed Tube will retain it's Virtue pretty long in dry Air, as appears by chaſing a Feather about the Room very long without new rubbing; as alſo by Lumps of Reſin and Sulphur, &c. which have been melted and poured into dry Drinking-glaſſes, keeping their Virtue long, if kept in thoſe Glaſſes, and wrapped in dry Silk, or ſuch Sort of Paper as will become electrical by rubbing; for as often as they are expoſed to the Air, they will attract.

4. *Electricals per ſe* communicate their Virtue to any of the *Non-electrical*, when brought near them; in which Caſe the *Non-electricals* attract and repel like the *Electricals per ſe*. Thus an Iron Bar ſuſpended by a ſilken Thread, an Hair Rope, or a dry Cat-gut, when an excited *Electric per ſe* is brought near it, will both attack and ſend out it's *Effluvia* to a *Non-electric* held near it; as appears in the Dark by the Light coming out at the End of the Bar.

5. An *Electrical per ſe* loſes it's excited Virtue in communicating to the *Non-electrical*; and the ſooner, the more of thoſe Bodies are near it. Thus in moiſt Weather the rubbed Tube holds it's Virtue but a little while, becauſe it acts upon the moiſt Vapours that float in the Air; and if the rubbed Tube be applied to Leaf-Gold or Braſs, laid upon a Stand, it will act upon it much longer, and more ſtrongly, than if the ſame Quantity of Leaf-Gold is laid upon a Table, which has more *Non-electrical* Surface than the Stand.

6. When a *Non-electrical* is ſuſpended by, or only touches an *Electrical per ſe*, it receives the Properties of an *Electrical per ſe* from a rubbed Tube or Wax, &c. This appears by the Fire that flaſhes from the Fingers of a Man ſuſpended by Hair-Ropes, or who ſtands upon a Cake of Reſin, when he has received Virtue from the rubbed Tube.

7. The Virtue which a *Non-electrical* receives from a rubbed Tube, runs on to the moſt diſtant Part of the ſuſpended Body from the Place where the Tube is applied, and ſeems to be collected there, from whence it flaſhes in the Dark, ſnaps and exerts it's Attraction upon the Thread of Trial; though as the Virtue runs along, it ſometimes ſhews itſelf in other Parts of the ſuſpended *Non-electrical*.

8. If a *Non-electrical*, whilſt it is receiving the Virtue from the rubbed Tube, be made to communicate with the Floor of the Room, or any other great *Non-electrical* Body by a *Non-electrical* String, how ſmall ſoever, (though but a Thread) the Virtue will not ſhew itſelf, as it did before, at the Extremities, where the Flaſh of Light was ſeen.

9. If a *Non-electrical* be ever ſo big, when ſuſpended, it will receive Electricity from the rubbed Tube. And if five or ſix hundred Foot long, when the rubbed Tube is applied at one End, the Bodies hanging at the other End will become electrical. This has been tried by ſeveral People as well as myſelf.

10. If a long *Non-electrical* String be faſtened to an *Electrical per ſe*, and extended to a great Diſtance, being ſupported by *Electricals per ſe* to keep it from touching the Ground, all Bodies faſtened at the End of it will become electrical when the rubbed Tube is applied at the other End, though the Tube does not touch it, but is only brought within two or three Inches of it.

N. B. This String we have before called the *Conductor of Electricity*, and the Cat-gut or ſilken Strings, Glaſs Tubes, or whatever kept the long String from touching the Ground, *Supporters*.

11. If any of the *Supporters*, mentioned in the laſt Obſervation, be changed for a *Non-electrical* Supporter, the Virtue will there be ſtopped and taken away by that *Supporter*: But if that *Supporter* be again ſupported by *Electricals per ſe*, it will only receive ſo much Electricity as will impregnate it, and then the Virtue will go on to the End of the String, and impregnate the Bodies faſtened to it.

12. The *Non-electricals* receive the greateſt Virtue at the End of the String, and moſt of all, if they are wet. But the *Electricals per ſe*, if long Bodies, as long Sticks of Wax, and Glaſs Tubes, only become electrical at the End next to the String.

13. *Electricals per ſe* will become *Non-electricals* if they be wet, or only moiſtened. Thus Supporters that tranſmit the Electricity immediately, ſtop it when wet with a Spunge, or when blown through, if open Tubes. And if the long *Electricals per ſe*, hanging at the End of the Conductor, be made wet, they will become *Non-electricals*, and ſtrongly receptive of the Virtue given by the rubbed Tube at the other End of the String.

N. B. All the ſix Experiments mentioned in the Beginning of this Paper, confirm this Obſervation.

14. A *Non-electrical* having been impregnated with Electricity by the rubbed Tube, is repelled by it, till it has loſt it's Electricity by communicating it to another *Non-electrical*. Then being in it's firſt State, it is again attracted by the Tube, which holds it till it has fully impregnated it; then it repels it again. This is evident, by attracting a Down Feather by the Tube in the Air, and then repelling it, ſo as to make it dance backwards and forwards to and from a Finger held up at a Foot or two from the Tube. But the Thing appears more plainly from the following.

Having rubbed the Tube T *t*, and with it attracted a Feather, the Feather at *t* was repelled from the Tube, whenever it was brought near it; but ſuddenly dipping the End T of the Tube in Water, the Feather floating in the Air came to it again, and ſtuck to the End of the Tube at T, or near F. Exper. 7. Fig. 3.

N. B. In fair Weather this Experiment will not ſucceed, unleſs the Tube be thruſt pretty deep into Water (a Foot at leaſt); but in moiſt Weather an Inch or two will do.

P. S. Though animal Subſtances be generally thought to be *Electrical per ſe*, yet it is only when they are very dry: This is the Reaſon why a living Man ſuſpended by a Hair Rope, or ſtanding upon a Cake of Reſin, to receive Electricity from the Tube, muſt be conſidered as a *Non-electrical*, by reaſon of the Fluids of his Body.

14. Having heard that Electricity had been carried along an hempen String 5 or 600 Foot long, but having only ſeen it when the String was carried backwards and forwards in a Room by Silk *Supporters*, I was willing to try it with a Packthread String ſtretched out at full Length; for which Purpoſe having joined a Cat-gut String of 6 Foot long, I faſtened it to the Inſide of a Door in the Suit of Rooms at *Cliefden*; and having alſo tied another Cat-gut, like the firſt, to the other End of the String, I tied it up to the Inſide of the Door at the other End of the Houſe; but at the Place where the Packthread was joined to the Cat-gut, I left a Foot and an half of Packthread hanging down, and faſtened to it a *Lignum Vitæ* Handle of a Burning-Glaſs; then applying a rubbed Tube at the other End of the String, I made the Electricity run to the *Lignum Vitæ*, but with ſome Difficulty, which I attributed to the Size, being an animal Subſtance that ſtill ſtuck to the Packthread as it was new; therefore I cauſed the Packthread to be wet with a Spunge from one End to the other, to waſh off the Size: Then was the Electricity from the Tube communicated very ſoon, and very ſtrongly; for the Thread of Trial (mentioned in my former Papers) was drawn by the *Lignum Vitæ* at the Diſtance of a Foot.

An Account of ſome electrical Experiments made at his Royal Highneſs the Prince of Wales's *Houſe at* Cliefden, April 15, 1738, *where the Electricity was conveyed* 420 *Feet in a direct Line. By the ſame. Ibid.* p. 209.

Afterwards, having joined more Packthread together, I made a String of 420 Foot long, one End of which I faſtened (by the Interpoſition of Cat-gut as before) to the Iron Gates in the Garden, before the Houſe, and the End which had the *Lignum Vitæ* Handle, to the upper

upper Part of the Door next to the Back-ſide of the Houſe in a large Drawing-Room, taking Care that the String came through the Middle of the opened Doors through which it paſſed; and to prevent this String dragging upon the Ground, three Pieces of Cat-gut held acroſs by two Men, at equal Diſtances from the Ends, and from each other, ſupported it. The String was altogether dipped in a Pail of Water, before the Experiment; but great Care taken, that the Cat-gut ſhould not be wet.

Then I applied the rubbed Tube at the End in the Garden, whilſt my Aſſiſtant held the Thread of Trial near the Handle above-mentioned, which Thread was ſtrongly attracted, though the Wind was very high, and blowed in the contrary Direction to that in which the Electricity ran along.

I firſt tried the Experiment with the Packthread dry, but then it would not do at that Diſtance.

N. B. The Weather was moiſt when I made the Experiment.

Some Things concerning Electricity. By the ſame, No. 459. p. 634. Jan. &c. 1741.

15. About a Year or two ago, in a Paper I gave in to the *Royal Society*, I endeavoured to eſtabliſh ſome general Principles concerning Electricity, from the Conſideration of many Experiments, which have been tried by others, as well as ſome new Experiments by myſelf, an Account of which I then gave. Therefore I ſhall only now repeat my Diſtinction of all Bodies into two Claſſes, in reſpect of Electricity, and make good the Definitions that I gave by ſome further Experiments; and though I do not pretend to know the Cauſe of Electricity in general, yet I hope from a few Laws of Electricity, deduced from known *Phænomena*, to ſolve moſt other *Phænomena*, (though ſeeming quite unaccountable) ſo far as to ſhew what Law of Electricity they depend upon; and to be able to foretel what will happen to moſt Bodies before the Experiments are tried upon them in an electrical Way.

1. Bodies electric *per ſe* are ſuch in whom a Virtue of attracting and repelling ſmall Bodies at a Diſtance is inherent, though it is not always in Action, ſo as to produce that Effect. But by rubbing, patting with the Hand, hammering, warming, and ſometimes only expoſing to dry Air, ſuch Bodies exert the Virtue above-mentioned; otherwiſe they are in a Non-electric State.

2. Non-electric Bodies are ſuch in which no electrical Virtue can be excited by any Action upon the Bodies themſelves, ſuch as rubbing, warming, *&c.* But an Electric *per ſe*, when excited, can communicate it's Virtue to a Non-electric, and that Virtue will be received by all the Parts of the Non-electric, (be the Body ever ſo long or large) and be ſtrongeſt, being, as it were, collected at that End of the Non-electric, which is fartheſt from the Place where the Electricity is firſt received.

3. A Non-electric, having received Electricity, will communicate to nother Body brought to touch it, or only brought pretty near, and that often

often with a ſnapping Noiſe, and a ſmall Flaſh of Light, loſing by that Means all it's own Electricity.

4. An Electric *per ſe* will become a Non-electric for a time, if it be made wet or moiſt, and become receptive of Electricity, which it will receive at one End, and carry to the other, where the Electricity will go off with a ſmall Exploſion, to impregnate any other Non-electric, which is brought near.

5. An Electric *per ſe*, in which Electricity has been excited, may become Non-electric by being expoſed to moiſt Air, whoſe humid Vapours it attracts; and then, brought to the Fire, or into very dry Air, recover it's Electricity when the Moiſture is exhaled again.

6. An Electric *per ſe* may be made ſtrongly electric in Part of it's Length, whilſt the other Part remains in a Non-electric State.

7. A Body in a State of Electricity (whether a Non-electric having received Electricity, or an Electric *per ſe*, excited to Electricity) will attract all Non-electrics, and repel other Bodies that are in a State of Electricity, provided the Electricity be of the ſame kind.

8. A Non-electric Body will not retain the Electricity which it receives from an Electric *per ſe*, unleſs it be free from touching any other Non-electric Body; but muſt be ſuſpended or ſupported by Electrics *per ſe* touching only them and the Air.

9. An Electric *per ſe*, when it is not reduced to a Non-electric State, will not receive Electricity from another Electric *per ſe*, whoſe Electricity is excited, ſo as to run along it's whole Length; but will only receive it a little Way, being (as it were) ſaturated with it.

10. An Electric *per ſe* will not loſe all it's Electricity at once, but only the Electricity of ſuch Parts of the Body as have communicated it to other Bodies, or near which Non-electrics have been brought.

11. When a Non-electric, which has received Electricity, communicates it's Electricity to another, it loſes all it's Electricity at once; and the *Effluvia*, in coming out, ſtrike the new Body brought near, as well as the Body firſt made electric.

12. Excited Electricity exerts itſelf in a Sphere round the Electric *per ſe*; or rather a Cylinder if the Body be cylindric.

13. The Electricity which a Non-electric of great Length (for Example, a hempen String 800 or 900 Feet long) receives, runs from one End to the other in a Sphere of electrical *Effluvia*. But all the Supports of this String muſt be Electrics *per ſe*.

14. If this String be branched out into many Strings, the Electricity will run to all their Ends.

15. If the Non-electric String, which is to receive and carry on the electric *Effluvia*, be not continuous, but has between it's Ends ſome Electrics *per ſe*, the *Effluvia* will ſtop at the firſt of them, unleſs the Interruption or Diſcontinuation of the Non-electric be ſhort; becauſe in that Caſe the Electricity jumps from the End of the firſt Non-electric to the Beginning of the next, eſpecially if the Air be very dry, even though

the

the Ends of the String ſhould be about a Foot diſtant, and no Body but the Air between. Sometimes indeed the Diſtance muſt not be above an Inch or two.

There are Two Sorts of Electrics *per ſe*, known by what follows: A Body impregnated with Electricity from one Sort will repel all Bodies that have that Sort of Electricity, till they have loſt their own Electricity by coming to ſome Non-electric. But an Electric *per ſe* of the other Sort, though excited, will attract all thoſe Bodies, though in a State of Repulſion, on account of the other Electricity; and ſo *vice verſa*.

An Account of ſome Electrical Experiments made before the RoyalSociety, Jan. 22. 1740 1 *by the ſame. Ibid.* p. 637.

16. It being a Matter in Diſpute, whether there is any Difference between the Electricity of Glaſs, and that of Gums and Reſins, I made the following Experiments, in order to ſettle that Point:

I faſtened a String of dry Cat-gut (which, when dry, is an Electric *per ſe*) from one Pillar to the other, at the End of the Table in the Meeting-Room of the *Royal Society*, about 7 Feet from the Floor; and to the Middle of that Cat-gut faſtened a ſilken Thread about 2 Foot long, which hung down, and at it's lower End had a Down Feather. Then rubbing the End of a Stick of Wax pretty quick and ſtrongly againſt my Waiſtcoat, which was made of Cloth, the Wax became electrical, and attracted the Feather, which ſtuck to it awhile, and then was repelled from it, as long as it retained the Electricity it had received from the Wax: But, having touched the Feather with my Finger, it loſt it's Electricity; and, becoming a Non-electric, was again attracted by the Wax, which gave it freſh Electricity; and then it was repelled from it, and ſo *toties quoties*. When the Feather was in it's electric State, I applied to it another Stick of Wax, which I firſt rubbed; and it repelled the Feather, though it had not touched it before, and did the ſame as the other Stick of Wax had done.

After that I rubbed a Glaſs Tube, which firſt attracted and then repelled the Feather, as the Wax had done: And another Tube being rubbed, repelled the Feather, when it was put into an electric State by the firſt Tube, without firſt attracting it. But Non-electrics, ſuch as the Finger, or a Stick, attracted the Feather, when it had firſt been made electric; and not only ſo, but Electrics *per ſe*, when they were become Non-electric, as the Tube unrubbed, or the Wax unrubbed; nay, the rubbed Tube alſo, when it's End was moiſtened, or that End of it turned to the Feather, which had been held in the Hand.

Then I made the Feather electric, by the Application of the excited Tube; and, having rubbed the Wax to give it Electricity, I brought it near the Feather, which it attracted ſtrongly, though it had repelled it before, when the Feather had been made electric by Wax.

Afterwards I made the Feather electric by the Wax, which firſt attracted and then repelled it: And, having applied the rubbed Tube to the Feather, it attracted it ſtrongly, though it repelled it when the Feather was made electric by another Glaſs Tube.

Having

17. Having ſhewn lately, by ſome plain Experiments, that the Electricity of Glaſs is different from that of Sealing-Wax, becauſe the Wax attracted a Feather ſuſpended in the Air by a fine Silk, when the rubbed Glaſs Tube repelled it, (as deſcribed in the Account of thoſe Experiments) I made the Experiment with a Cake of Roſin inſtead of Sealing-Wax; and it appeared to have the ſame Kind of Electricity as the Sealing-Wax. Then conſidering that the Supporters of any Non-electric Conductors of Electricity muſt themſelves be electric, I had a Mind to try whether Bodies, endued with either Kind of Electricity, were in any-wiſe different in that Caſe; which I did by the following Experiments: *Electrical Experiments made before the* Royal Society, March 15, 1740-1. *By the ſame. Ibid.* p. 639.

I laid a Piece of Wood, 4 Foot long, on 2 Glaſs Plates, whoſe Ends ſtood one Foot beyond the Side of the Table on which they were laid: Then, applying the rubbed Tube to one End of the Wood, the other attracted Leaf braſs, or a Thread hanging down from a Stick. Then, inſtead of the Glaſs Plates, I laid the long Piece of Wood on two Cakes of Roſin, and applied the rubbed Tube to the End of the ſaid Wood, which conducted the Electricity to the other End, where Leaf-braſs and the Thread were attracted in the ſame Manner.

This ſhews that, in order to conduct Electricity along any Non-electric Body, it is indifferent what Kind of Electricity it's Supporters are endowed with, provided they are electric.

18. I mentioned in one of my former Papers concerning Electricity, that Electrics *per ſe* would not receive the Electricity of a rubbed Tube, ſo as to carry on to a Diſtance; but that, if thoſe Bodies were changed into Non-electrics, they would then receive and convey the Electricity of the rubbed Tube in the ſame Manner as all other Conductors of Electricity do. The Experiments which I made to prove this plainly, are as follow: *An Account of ſome Experiments made before the* Royal Society, May 14, 1741. *By the ſame.* No. 460, p. 661.

I ſuſpended a long ſmall Glaſs Tube at about the Diſtance of 14 or 15 Inches from a horizontal extended Cat-gut in the ſame Poſition, or parallel to it, by two ſmall ſilken Threads; and, with a ſmall Packthread, hung an Ivory Ball on the End of the ſuſpended Tube; and, applying the rubbed Tube to the other End, (though lightly excited, as appeared by it's ſnapping) no Electricity was communicated to the Ball: Though, when a very ſmall Packthread was hung from one End of the Tube to the other, the Ivory Ball became very electric, as appeared by it's attracting a Thread hung on a Stick. Then taking off the Packthread, and wetting the Tube from one End to the other with a Spunge, it became a Non-electric, and conveyed the Electricity to the Ball as ſtrongly as the Packthread had done. Exper. 1.

The Tube being well dried, I applied a Silk in the ſame Manner as I had done the Packthread; but no Electricity could be conveyed to the Ball by applying the rubbed Tube to the contrary End of the Silk: But afterwards, having wetted the Silk, it became a Non-electric, and received the Electricity, which it communicated to the Ball. Exper. 2.

N. B. I choſe a Glaſs Tube for this Experiment, becauſe Mr *Du Fay* had made uſe of Glaſs Tubes for the Supporters of his Conductors of Electricity; and Silk, becauſe Mr *Gray* had ſupported his Conductors of Electricity upon Silk.

An Account of ſome Experiments made before the Royal Society, May 28, 1741. *By the ſame. Ibid.* p 662. Exper. 1. Fig. 4.

19. That it is not the Quantity of Matter in Bodies, that makes them more or leſs receptive of Electricity, and conductive of it, but entirely their Quality, appears by the following Experiments.

From a Cat-gut String A B, about 12 Foot long, ſtretched horizontally 6 Foot above the Floor of the Room, I ſuſpended two Iron Bars C D, E F, of about 40 Inches long, and a Quarter of an Inch ſquare, by the ſilken Strings C *c*, D *d*, E *e*, F *f*, which at firſt touched at their Ends D, E; and from the End F of the Bar E F there hung, by a Packthread, the Ivory Ball G. Then having rubbed a large Tube I K to excite it's Electricity, I applied it near the End C of the firſt Bar; and the electrical Virtue ran along the two Bars, and impregnated the Ball G, as appeared by it's attracting the Thread hanging from the Stick H, at about 3 Inches Diſtance. Afterwards I ſeparated the Tubes in the Manner that they appear in the Figure, and the Electricity was communicated to the Ball but faintly when the Bars were 1 ½ Inch aſunder, and not at all when they were 2 ½ Inches aſunder. But this was owing to the moiſt State of the Air; for, when the Air is very dry, the Virtue will jump 6 or 9 Inches; but when the moiſt Particles, that float in the Air, are attracted by the Bars, the Virtue will reach but a little Way; though, if that Moiſture be fixed upon any Body, which (being an Electric *per ſe*) would not conduct the Electricity applied to it's End, the Virtue will be carried from one Bar to another as well as if they had touched, as will farther appear by the next Experiment.

Exper. 2. Fig. 5.

Having ſeparated the hanging Bars ſo far aſunder, that the Electricity could not jump from the one to the other, (*viz.* about 3 Foot) I laid upon their End the ſmall Tube D E, having wiped it very dry: Then applying the rubbed Tube to C, the Virtue ſtopped at D; and neither the Bar E F, nor the Ball G, received any Electricity, the Thread H being attracted by neither of them. But, having blown through the Tube, the Moiſture of the Breath changes it from an Electric to a Non-electric; and then the Virtue of the rubbed Tube runs along freely from C quite to the Ball at G, which then ſtrongly attracts the ſuſpended Thread.

N. B. When the Air is very moiſt, the Tube D E is turned to a Non-electric without blowing, only by the watery Particles adhering to it.

Exper. 3. Fig. 6.

The Bars remaining in their Situation, I took off the Tube, and ſtretched a very fine white flaxen Thread from D to E, which touched both

both Bars: Then applying the rubbed Tube to C, the Virtue was carried from Bar to Bar, and the Ball G attracted the Thread H at 2 Inches Diſtance. Afterwards wetting the Thread, the Attraction became much ſtronger at G, ſo as to attract the Thread H at 4 or 5 Inches Diſtance.

Having joined together the Ends of the ſuſpended Bars, I ſuffered the Thread D *d* to hang down, but touching no other Body; then the Electricity was freely communicated (by applying the rubbed Tube to C) from C to the Ball at G. But if *d*, the lower End of the Thread, touched the Ground, or a Chair, or was taken hold of by any body's Hand, or lifted up by a walking Cane; then the Electricity advanced no farther on the Bars than D, but was interrupted by the Thread D *d*, and carried to the Bodies contiguous to *d*, when they are Non-electric. If the End *d* of the Thread was laid upon a dry Glaſs Tube, held in the Hand of an Aſſiſtant, then the Electricity ran as before along the Bars to the Ball G. The ſame Thing alſo happened when the End *d* of the Thread was thrown up upon the Cat-gut String; for in that Caſe the Electricity, having impregnated the String, did afterwards run along the Bars, *&c.* Exper. 4. Fig. 7.

20. Having found by ſeveral of Mr *Gray*'s Experiments, as well as ſome of my own, that Water is receptive of Electricity, ſo as to be raiſed up in a little Cup, to emit a Vapour towards the rubbed Tube, to ſnap, and to give Light; having alſo found, (as I ſhewed the Experiment before the *Royal Society*) that when a dry Tube, ſuſpended horizontally, will not conduct the Electricity of the rubbed Tube applied to one of it's Ends; and yet, when blown into, will conduct it ſtrongly all it's Length, becauſe the Electricity runs along from one moiſt Particle to another, though thoſe Particles are not contiguous. I thought that Electricity might impregnate a whole Jet of Water, whether perpendicular, oblique, or horizontal: And ſuppoſed alſo, that if at any Time there be electrical *Effluvia* in or above a Cloud, that Virtue may be communicated by the falling Rain, to any thing that the Rain falls upon. How far my Conjecture is true, will appear by the following Experiment: *An Account of ſome new Electrical Experiments, performed before the* Royal Society, Aug. 29, 1741. *By the ſame. Ibid.* p. 666.

Having properly ſuſpended (that is, ſuſpended by ſome electric Body, here Cat-gut) a Copper Fountain with the Spout downwards, I opened the Cock, and let the Water ſpout into a Veſſel underneath: Then, having excited a great Tube to Electricity, I held it over the Copper Fountain, whilſt an Aſſiſtant held the Thread of Trial (that is, a Thread hanging from a Stick) near ſeveral Parts of the Jet, which attracted it ſenſibly: Then I applied the rubbed Tube near to the falling Jet, which attracted it ſtrongly, ſo as to bend it into a Curve, and ſometimes cauſe it to fall out of the Veſſel below.

21. Electrics *per ſe* (which I have heretofore defined, *Bodies in which an electrical Virtue may be raiſed by ſome Action on them*, ſuch as Rubbing, Patting, Warming, *&c.*) are reduced to a Non-electric State by *Some further Obſervations concerning Electricity;*

by the ſame. No. 462. p. 14. *Read* Jan. 14, 174½.

being in Contact with Non-electric Bodies, eſpecially Water, which is the greateſt Non-electric, even when it becomes Vapour.

A Non-electric (which though it cannot be made electrical by any Action upon it) receives Electricity from an excited electrical Body; but does not retain it whilſt it touches any other Non-electrical Body. An Electric *per ſe*, when it is become Non-electrical, differs from the Non-electric *per ſe* in this; that it may be ſo reſtored to Electricity, by applying a rubbed Tube to it, as to repel all other Electrics of the ſame Kind of Electricity as the Tube; till it meets with ſome Non-electric Body, which brings it back to Non-electricity, or at leaſt to ſuch a languid State, that it's Electricity is ſcarce perceptible.

The Electricity may be alſo reſtored in the ſame Manner by Wax, *&c.* But in both Caſes, an electric Body, in a languid State, cannot be reſtored to Electricity whilſt it adheres to a Non-electric *per ſe*.

Experiments to illuſtrate theſe Aſſertions.

From an horizontal Cat-gut (which is an Electric *per ſe*, as moſt animal Subſtances are) I ſuſpended 2 Feathers, the one by a Thread, and the other by a Silk, about 2 Foot long each: Then applying the rubbed Tube to the Feather hanging by the Silk, (which Silk is an Electric *per ſe*) the Feather came to the Tube, and ſtuck to it, as all Non-electric Bodies do, till it was ſo impregnated with the Virtue from the Tube, as to come out of it's languid State, and become ſtrongly electrical; which appeared by it's flying from the Tube, and being repelled as often as the Tube was brought near it; till it had touched ſome Non-electric Body, or was left ſo long as to imbibe the moiſt Particles floating in the Air, by which it became Non-electric, and was again attracted by the Tube.

When I applied the Tube to the other Feather that hung by the Thread, (which, like moſt vegetable Subſtances, is generally Non-electric *per ſe*) the Feather was conſtantly attracted, and never repelled; becauſe the Virtue communicated from the Tube to the Feather, loſt itſelf along the Thread; which would have been retained by the Feather, if it had floated in dry Air, or been ſuſpended by an electrical Body.

Theſe Properties of electric Bodies ſhew the Reaſon of that *Phænomenon*, whereby a rubbed Tube, after having attracted a Feather, repels and chaſes it about a Room in the Air, and does not attract it a ſecond Time, till the Feather has touched ſome other Body; and alſo ſhews the Reaſon why the Experiment does not ſucceed in moiſt Weather.

Pure Air, that is dry, may be ranked among the Electrics *per ſe*, becauſe it repels all Bodies in a State of Electricity, whether they have been excited to it by Wax or Glaſs; that is, by either of the two Sorts of Electricity.

Watery Vapours, that float in the Air, are Non-electric; from which Mixture the Air becomes more languid in it's Electricity, when moſt impregnated with Vapours; ſo that dry Air is more electric than moiſt;

moiſt; but cold Air in froſty Weather, when Vapours riſe leaſt of all, is more electric than Air in Summer, when the Heat raiſes Vapours; which renders that State of the Air more fit for making electrical Experiments.

The rubbed Tube retains it's Electricity a long Time, becauſe it repels, and is repelled by the dry Air; and the Feather, which has been attracted by the Tube, after adhering to it a-while, is raiſed out of it's languid State to a ſtrong Electricity; whereby it flies from the Tube, repels and is repelled by the Air, where meeting with very few Vapours, it retains it's Electricity a long Time; till touching a Non-electric, that is brought to it, it loſes it's own Electricity by communicating it, becomes a Non-electric, and is re-attracted by the Tube, to which adhering ſome Time, it receives ſo much Virtue from the Tube, as to be reſtored to it's Electricity, and again repelled.

In a moiſt State of the Air, the Feather, after it has been made electrical, and repelled by the Tube, it attracts to it the moiſt Vapours floating in the Air; whereby, loſing it's Electricity, it is attracted by the Tube, without touching any other Body firſt.

Sometimes when the Feather flies off from one Part of the Tube, it immediately returns to another Part, generally the Top of the Tube, becauſe the Top of the Tube has attracted the moiſt Vapours, and is become a Non-electric, and therefore attracts the Feather; which being become electric, flew off from the electric Part of the Tube.

That this is true, appears from an Experiment to be made in dry Weather.

At that Time, when every Part of the Tube repels the Feather ſtrongly, after having attracted it, if you wet 2 or 3 Inches of the upper End of the Tube, the Feather will come to that End.

Wetting the Silk by which the Feather hangs from the Cat-gut, the Feather will be always attracted, and not repelled.

When the Silk is dry, the Feather once made electrical, ſo as to be repelled by the Tube, retained that Virtue above two Hours in froſty Weather; but in moiſt Weather loſt it in half a Minute.

22. It is proper firſt to mention, by way of Preliminary, that M. *Du Faye*'s Aſſertion of two Sorts of Electricity is found to be true by Obſervations and Experiments, *viz.* that Bodies endowed with the vitreous Electricity repel one another, and attract thoſe that have the reſinous Electricity; on the contrary, thoſe that are endowed with the reſinous Electricity, repel one another, but attract thoſe that have the vitreous Electricity. *Some Conjectures concerning Electricity, and the Riſe of Vapours. By the ſame.* No. 464. *Read* June 24, 1742.

I ſuppoſe Particles of pure Air to be electric Bodies, always in a State of Electricity, and that vitreous Electricity.

1*ſt*, Becauſe Particles of Air repel one another without touching, as has been deduced from Experiments and Obſervations.

2*dly*, Becauſe when the Air is dry, the Glaſs Tube rubbed (or only warmed) throws out it's *Effluvia*, which the Air drives back to the Tube,

Tube, from whence they dart out anew, and ſo move backwards and forwards with a vibratory Motion, which continues their Electricity.

3dly, Becauſe the Feather made electric by the Tube, and darted from it, keeps it's Electricity a long Time in dry Air; whereas, when the Air is moiſt, the moiſt Particles, which are Non-electric, being attracted by the Feather, ſoon make it loſe this Electricity, which alſo happens even to the Tube in a little Time.

From this Conſideration it will be eaſy to account for a famous Experiment of the late Mr *Hawksbee*, which is this:

Having pumped out all the Air from a Glaſs Globe, he cauſed it to turn on it's Axis very ſwiftly, by Means of a Rope with a Wheel and Pully; then rubbing the Glaſs with his Hand during it's Motion, there appeared a great deal of Light of a purple Colour within the Globe, without any Light or Attraction obſerved on the Outſide of the Glaſs, which is obſerved when the Air has not been pumped out. Then turning the Cock ſo as to re-admit the Air gently into the Globe during it's Motion, the Light was broken and interrupted, diminiſhing gradually, till at laſt it appeared only on the Outſide of the Glaſs, where it was accompanied with Attraction. Does it not appear to be, that at firſt the external Air by it's Reſiſtance drives back the electric *Effluvia*, which go then to the Inſide of the Globe, where there is the leaſt Reſiſtance? For we obſerve, that as the Air comes in, it repels the electric *Effluvia*, that go inwards no longer, when all the Air is come in. If the Fact be ſo, as the Experiment ſhews, is not my Conjecture proved, *viz.* that the Air is electrical?

In Dr *Hales*'s *Vegetable Statics*, ſeveral of his Experiments ſhew, that Air is abſorbed, and loſes it's Elaſticity by the Mixture of ſulphureous Vapours, ſo that four Quarts of Air in a Glaſs Veſſel will be reduced to three. Will not this *Phænomenon* be explained by the different Electricity of Sulphur and Air? The *Effluvia* of Sulphur, being electric, repel one another; and the Particles of Air, being alſo electric, do likewiſe repel each other. But the Air being electrical of a vitreous Electricity, and Sulphur of a reſinous Electricity, the Particles of Air attract thoſe of Sulphur, and the *Moleculæ* compounded of them, becoming Non-electric, loſe their repulſive Force.

It has for a great while been thought, that watery Vapours, that riſe in Air to form Clouds, uſed to riſe, becauſe the Water which is of itſelf ſpecifically heavier than Air, (being formed into little hollow Spherules or Bubbles filled with an *Aura*, or thinner Air than the ambient Air) in this new State made a Fluid of little Shells, ſpecifically lighter than the ambient Air in which it muſt riſe. But Philoſophers are come off of that Opinion; and ſuch as have implicitly come into it, may find it refuted in the *Philoſophical Tranſactions* *.

* Vol. VI. Part ii. Chap. I. §. xix.

Now

Now may not this *Phænomenon* of the Riſe of Vapours depend upon Electricity in the following Manner?

The Air which flows at Top of the Surface of the Waters is electrical, and ſo much the more as the Weather is hotter. Now in the ſame Manner as ſmall Particles of Water jump towards the electric Tube, may not thoſe Particles jump towards the Particles of Air, which have much more ſpecific Gravity than very ſmall Particles of Water, and adhere to them? Then the Air in Motion having carried off the Particles of Water, and driving them away as ſoon as it has made them electrical, they repel one another, and alſo the Particles of Air. This is the Reaſon that a cubic Inch of Vapour is lighter than a cubic Inch of Air; which would not happen, if the Particles of Vapour were only carried off in the Interſtices of Air, becauſe then a cubic Inch of Air, loaded with Vapour, would be made ſpecifically heavier than an Inch of dry Air; which is contrary to Experiments, which ſhew us by the Barometer, that Air which is moiſt, or full of Vapours, is always lighter than dry Air.

V. Attraction and Repulſion ſeem to be ſettled by the great *Creator* as firſt Principles in Nature; that is, as the firſt of ſecond Cauſes; ſo that we are not ſollicitous about their Cauſes, and think it enough to deduce other Things from them. If Elaſticity was admitted as a firſt Cauſe, (as it is by ſome) it is thought we ſhould admit of too many principal Cauſes in Nature, which is contrary to the Rules of good Philoſophy. Philoſophers therefore have endeavoured to deduce Elaſticity from Attraction, or from Repulſion, or from both. It is obſerved, that the ſame Particles that repel each other ſtrongly, will attract other Particles very ſtrongly, as appears by many Chemical Diſſolutions, eſpecially by the alternate Diſſolution and Precipitation of Metals in acid *Menſtruums*. The reverend and learned Dr *Hales* has proved this many Ways, in his *Vegetable Statics* and *Hæmaſtatics*. The Elaſticity of Air ſeems to conſiſt wholly in the repulſive Power of it's Particles, which do not touch one another while the Air is in it's elaſtic State; and if thoſe Particles be brought nearer and nearer together, the Effect of their repulſive Force will increaſe, the Air's Elaſticity being always proportionable to it's Denſity by Compreſſion, which Property will be preſerved, though compreſſed Air be kept a Year or two; notwithſtanding Mr *Hawksbee*, in his *Phyſico-mechanical Experiments*, ſays, that Air will loſe Part of it's Spring by being very much compreſſed: But the Air with which he tried it, muſt have been filled with moiſt Vapours; and it is well known, that the Steam of Liquors will loſe it's Elaſticity, eſpecially where it's Heat decays. I have kept ſeveral Wind-Guns, ſtrongly charged, for half a Year together, in which the Air had loſt none of it's Elaſticity: Others have found the Air as ſtrong after a Year; and I have been told by a Perſon of Credit, that a Wind-Gun having been laid by and forgotten for ſeven Years, when it was found, diſcharged it's Air as many Times, and with as much Force, as it uſed

Some Thoughts and Conjectures concerning the Cauſe of Elaſticity. By the ſame, No. 454. p. 175, July, &c. 1739.

to

to do. Now, though Air, compreſſed by any external Force, does always increaſe in Elaſticity, as it diminiſhes in Bulk; yet it may, by Fermentation, diminiſh it's Bulk very much, without gaining any more Elaſticity: For if another Fluid, whoſe Parts repel one another, but attract the Parts of Air, be mixed with Air, the Repulſion of any two Particles of Air will be diminiſhed, in Proportion as a Particle of the other Fluid, inſinuating itſelf between them, attracts them towards itſelf on either Side. The ſame Thing will happen to the other Fluid, in reſpect of the Particles of Air, which mixing with it's Particles, do in the ſame Manner deſtroy their Repulſion. Thus, if we allow an Attraction ſtrong enough between the Parts of two elaſtic Fluids, it is poſſible, that by Fermentation a Solid may be made out of two elaſtic Fluids, which would have ſtill continued fluid without ſuch a Mixture. We are taught by Chemiſtry to mix Fluids together, which immediately coaleſce into a Solid. When Brimſtone Matches are burning, the *Effluvia* of the Sulphur repel each other to great Diſtances, as may be known by the ſulphureous Smell upon ſuch an Occaſion. Now, though theſe Particles repel each other, they attract the Air very ſtrongly, as appears by the following Experiment:

Take a tall Glaſs Receiver cloſed at Top, holding about 4 Quarts of Air, and having put it's open End over a Bundle of Brimſtone Matches on Fire, ſtanding up in the Middle of a large Diſh with Water in it, (to keep the Air from coming in at the Bottom of the ſaid Receiver) you will obſerve, that not only as ſoon as the Matches are burnt out, but a good while before, the Air, inſtead of being expanded by the Flame of the Brimſtone, will retire into leſs Compaſs, the Water beginning to riſe from the Diſh up into the Receiver, and continuing ſo to do till ſome Time after the Matches are burnt out; ſo that there will be in the Receiver only 3 Quarts of Air, inſtead of 4 (more or leſs, in Proportion to the Quantity of Brimſtone burnt): And this plainly happens by ſome of the *Effluvia*, or little Parts of the Sulphur, attracting ſome of the Particles of Air, ſo as to make an unelaſtic Compound, that precipitates into the Water. If the Elaſticity of the Air is quite loſt when the Repulſion of it's Particles is taken off, or ſufficiently counteracted, it muſt follow, that it's Elaſticity depends upon Repulſion: And that this is often the Caſe, appears by a great Number of Dr *Hales*'s Experiments, of which I will mention but a few. The Doctor took a cubic Inch of Mutton-Bone, and having put it into his Gun-Barrel Retort, he diſtilled out of it 2 or 300 cubic Inches of Air into a large Glaſs Bottle, the Weight of which Air, together with the Aſhes of the Bone left, weighed as much as the whole Quantity of Bone did at firſt. Now the Air had been confined in that Bone, together with many ſulphureous Particles, in ſuch Manner, that the mutual Attraction of the Sulphur and the Air had alternately deſtroyed each other's repulſive Force, and brought thoſe Subſtances into a little Compaſs; but the Fire in the Diſtillation ſeparated them from each other,

ſo

ſo as to reſtore them, in a great Meaſure, to their uſual Elaſticity. This appeared by bringing a Candle near the Mouth of the Bottle that held this revived Air; for every time the Candle was brought near, the Air took Fire, and flaſhed out of the Bottle with a ſulphureous Smell. The Air may be conſolidated in many hard Bodies, ſo as to be there quite void of Elaſticity, and there do the Office of a Cement, till by the Action of Fire, or ſome particular Fermentations, it is again reſtored to it's perfectly elaſtic State. This is the Meaning of the Doctor's Words, when he ſays, that ſome Bodies *abſorb*, and others *generate* Air; and the ſame Bodies do ſometimes abſorb, and at other times generate Air. He found more or leſs Air in almoſt every ſolid Subſtance that he tryed; but, what was moſt remarkable, he found that the *Calculus humanus* (or Stone taken out of a Man's Bladder) was made up of above half it's Weight of Air.

Some have endeavoured to ſolve Elaſticity by Attraction only; as for Example: If the String A B be conſidered as made up of Particles lying over one another in the manner repreſented at A D B; it is plain, that if the Point D be forcibly brought to C, the Parts will be pulled from each other; and when the Force, that ſtretched the String, ceaſes to act, the Attraction of Coheſion (which was hindered before) will take place, and bring back the String to it's former Length and Situation after ſeveral Vibrations. Now, though this ſeems to agree pretty well with the *Phænomena* of a String in Motion, it will by no means ſolve the Elaſticity of a Spring faſtened at one End, and bent either way at the other, like a Knife or Sword-blade. For if ſuch a Spring be bent from A to *a*, the Particles on the Side C, which now become convex, will be farther aſunder at F, while the Particles at D, carried to the concave Part E, will come cloſer together: So that the Attraction, inſtead of making the Spring reſtore itſelf, will keep it in the Situation in which it is, as it happens in Bodies that have no Elaſticity, where perhaps only Attraction obtains. Thus a Plate of Lead, a Plate of Copper, and a Plate of ſoft Iron, ſtands bent. Fig. 8. Fig. 9.

But the moſt probable way of ſolving the Elaſticity of Springs, is to conſider both a repulſive and an attractive Property in the Particles, after the manner of the black Sand, which is attracted by the Loadſtone, and has been ſhewn by the learned and ingenious Profeſſor *Petrus van Muſchenbrook*, to be nothing elſe but a great Number of little Loadſtones.

Let us ſuppoſe a Row of round Particles touching one another only in the Points *c* in a Line from A to B. It is plain, from what Philoſophers have ſhewn, concerning the Attraction of Coheſion, that upon the leaſt Shake, or Alteration of the Poſition of a ſtrait Line, theſe Particles will run together, and form a Sphere, in which the Globules will have more Points of Contact. But if theſe Particles have Poles like Magnets in the oppoſite Places marked *n*, *s*, ſo that all the Poles *n*, *n*, *n*, &c. repel one another; and all the Poles *s s s*, &c. do likewiſe repel Fig. 10.

one another, the Line A B will continue ſtrait; for if by any Force the ſaid Line B A be put into another Poſition, as into the Curve *b a*, then the Poles *n n*, &c. being brought nearer together, (while the Poles *s*, *s*, &c. are farther aſunder) will repel one another more ſtrongly, and thereby hinder the Globules from running together towards the concave Part; and the Spring, left to itſelf, (all this while ſuppoſing one End, as *b*, B, or β, fixed) will reſtore itſelf, throwing it's End *a* back to A, and ſo on to α, by the firſt Law: Then being in the Poſition α β, the Poles *s*, *s*, &c. are brought nearer together, whoſe Repulſion, thus increaſed, throws back α to A, and ſo on forward, the Line of Particles performing ſeveral Vibrations round B.

May not a Spring of Steel, or other Springs, conſiſt of ſeveral Series of ſuch Particles, whoſe Polarity and Attraction acting at the ſame time, will ſhew why ſuch Bodies, when they have been bent, vibrate, and reſtore themſelves?

If we take a Plate of Steel, and make it ſo hot till it looks white, and then immediately quench it, we thereby fix the Metal in a State very near Fluidity, ſo that the Particles which the Fire had almoſt brought to Roundneſs, have but a very ſmall Contact; as appears by the Fragility of the Steel thus hardned, which breaks like Glaſs, and has a ſhort Grain. Steel, thus hardened, is highly elaſtic; for what Workmen call *hard*, is the moſt *elaſtic*: As appears by the Congreſs of high-hardened Steel Balls, which return, in their Rebound, the neareſt to the Place we let them fall from; and, next to Glaſs have the quickeſt Elaſticity of any thing we know.

That we may not be thought to have given an imperfect Account of the Elaſticity of a Steel Spring, becauſe ſuch an one as we have deſcribed wants Toughneſs, and will immediately fly when bent to any Degree; we muſt beg Leave to conſider farther the Properties of the round Particles, or little Spheres, of Steel, in which we have ſuppoſed a Polarity.

Fig. 11. Let us ſuppoſe A B to be two little Spheres or component Particles of Steel, in which, at firſt we will ſuppoſe no Polarity, but only an Attraction of Coheſion. Then, whether the Particles have their Contact at *c*, *d*, *e*, *n*, or at δ, ε, *s*, their Coheſion will be the ſame; and the leaſt Force imaginable will change their Contact from one of thoſe Points to another; becauſe in the rolling of theſe little Spheres, they do not come into more or leſs Contact in one Situation than another. But if we ſuppoſe the Point *n* in each Spherule to be a Pole with a Force to repel all the other Points *n* in any other Spherule, and likewiſe *s* another Pole, repelling the other Points *s*; the Spherules will cohere beſt, and be at Reſt in that Poſition where the Points *c*, *c*, are in Contact, and *n* and *s* at equal Diſtances on either Side. For if the Spherules be turned a little,

Fig. 12. ſo as to bring the Points *d*, *d*, into Contact, the Poles *n*, *n*, being brought nearer, act againſt each other with more Force than the Points *s*, *s*, which are now farther off, and conſequently drive back the Spherules to the Contact at *c*, *c*, beyond which continuing their Motion, they will

will go to δ δ, and ſo backwards and forwards, till at laſt they reſt at *c*, *c*, which we may call *the Point of Æquilibrium for Reſt* in a Spring. Now there are beſides this, two other *Points of Æquilibrium*, beyond which the Spring may break, which are the Points *e*, *e* towards *n*, and ε, ε towards *s*; that is, when the Spherules have their Poles *n*, *n* brought very near together, the mutual Repulſion increaſes ſo, that the Attraction at the Contact is not able to hold them, and then they muſt fly aſunder, the Spring breaking. We ſuppoſe the Points *e*, *e*, to be the Points of Contact, beyond which this muſt happen; but that if the Contact be ever ſo little ſhort of it, as between *e* and *d*, the Spherules will return to their Contact at *c*, after ſome Vibrations beyond it, as has been already ſaid. This is the Reaſon why I call *e*, (in one of the Spherules) and it's correſpondent Point ε on the other Side *c*, *the Points of Æquilibrium*; for if the Spring be bent towards *a* (Fig. 10.) ſo that the Spherules, like A and B, (Fig. 14.) touch beyond *e*, the Spring will break: Likewiſe if the Spring be bent the other way, till the Spherules touch beyond ε, then it will break the other way. Now when the Spherules touch at *e*, *e*, or at ε, ε, the Spring is as likely to return to it's firſt Poſition as to break; for which Reaſon I have called the Points *e* and ε, *Points of Æquilibrium*, as alſo having known by Experience, that a Spring left bent to a certain Degree, has, after ſome time, broken of itſelf. Fig. 13. Fig. 14.

From all this it appears, that Spherical Particles will never make a tough Spring; therefore the Figure of the Particles muſt be altered, in order to render it uſeful; and this is what is done in bringing down the Temper of the hard Steel, and *letting down a Spring*, as it is called. What Change ought to be made in the Particles, we ſhall firſt ſhew; and then conſider how far that is done by thoſe who make Springs.

If the Parts ſuppoſed Globules, as in Fig. 10. are now flattened at *c*, where the Contact is, ſo as to put on the Shape *n e d c* δ ε *s*, the Contact will be much increaſed, and reach from *d* to δ, ſo that in bending the Spring there will ſtill remain a great Contact in the Particles, and the Points of *Æquilibrium* for breaking (*viz.* *e*, *e* above, and ε, ε below) will be removed nearer to the Poles *n*, or *s*, than when the Particles are round; the Conſequence of which will be, that the Spring muſt be bent much farther, to be in Danger of breaking, than in the former Suppoſition; as may be ſeen in Fig. 16. where two Particles being opened about the Point *d* as a Centre, the attracting Points *c*, *c*, and δ δ, have ſtill ſome Force to help to bring back the Particles to their whole Contact; becauſe in this Shape of the Particle the attracting Points *c*, *c*, δ, δ, are removed but in Proportion to their Diſtance from the angular Point *d*; whereas if the Particles had been ſpherical, and the Line *d* δ an Arc of a Circle, the attracting Points *c*, *c*, and δ, δ, would have removed from one another farther than in Proportion to twice the Square of the Diſtance from *d*, as in Fig. 12. and ſo have afforded very little Help for bringing back the Particles to their Contact. A Row of Particles in the Fig. 15. Fig. 16.

Fig. 17. Spring thus conditioned, is to be ſeen in the natural State at B A, Fig. 17. and bent at *b a* in the ſame Figure. Here it is to be obſerved, that if in this Figure of the Particles you would bend the Spring to bring the Particles to touch at their Point of *breaking Æquilibrium*, you muſt open them ſo much on the contrary Side, that the Spring will be bent far be-
Fig. 18. yond any Uſes intended to be made of it, as appears by Fig. 18, where two Particles are brought to touch at the equilibrating Point *e*; and by
Fig. 19. Fig. 19. where many Particles being put into that Condition, the Spring is brought round quite into a Circle.

Now the common Practice in making Springs is the moſt likely to produce this Effect required in the Particles; for the hard Spring, whoſe Particles were round, or nearly ſo, is heated anew, and whilſt it is cooling gently, the mutual Attraction increaſes the Contact, ſo that the Particles grow flatter in thoſe Places where before they had but a ſmall Contact; and leſt this Contact ſhould become too great, the Spring's ſoftening is ſtopped by quenching it in Water, or Oil, or Greaſe. Another way of making Springs, is to begin and ſhape them in cold unelaſtic Steel, and then having heated them to a ſmall Degree, for Example, to a Blood red Heat, immediately to cool them in ſome proper Liquors. This alſo ſettles the Particles in their oblong Figure, through which they muſt paſs before they become round, or nearly ſo, in a white Heat. That Particles of Steel are fixed in the Figures which they have at the Inſtant of dipping, will not appear ſtrange, when we conſider, that dipping red-hot Steel in cold Liquors, in a particular Poſition, makes it magnetical. If it be aſked, how we account for making Springs only with hammering, it is eaſily anſwered, That we can make Iron and Steel magnetical only with hammering; and if we can give and deſtroy Poles in the whole Piece, there is no Improbability to think we can give Poles to little Parts; or rather bring into a particular Situation the Poles which they have; for if the Poles that we have conſidered be placed quite irregularly, there will be no Elaſticity at all. Agreeable to this, Springs may be made of other Metals than Iron or Steel, though not ſo perfect, by Hammering; for it will be ſufficient for the little Particles to have Poles that attract and repel one another, driven by the Hammering into a regular Order.

N. B. *This applied to the Vibration of a String, will better ſolve it's ſeveral Caſes than Attraction alone*; and the Elaſticity of Glaſs is juſt the ſame as that of a very brittle *Steel-Spring*.

A Deſcription of a Barometer, wherein the Scale of Variation may be increaſed at Pleaſure. By

VI. A B C D, is a Cylindrical Veſſel filled with a Fluid to the Height W, in which is immerged the Barometer S V, conſiſting of the following Parts; the principal of which is the Glaſs Tube T P (repreſented ſeparately at *t p*) whoſe upper End T is hermetically ſealed: This End does not appear to the Eye, being received by the lower End of a Tin Pipe G H, which in it's other End G receives a Cylindrical Rod,

Fig. 1.

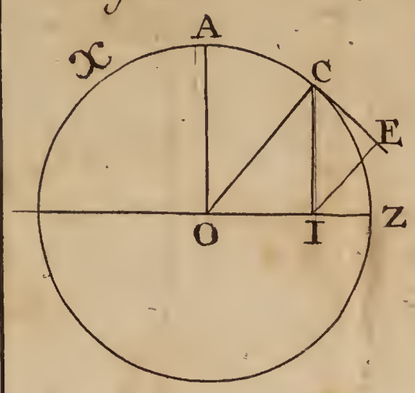


Fig. 2.

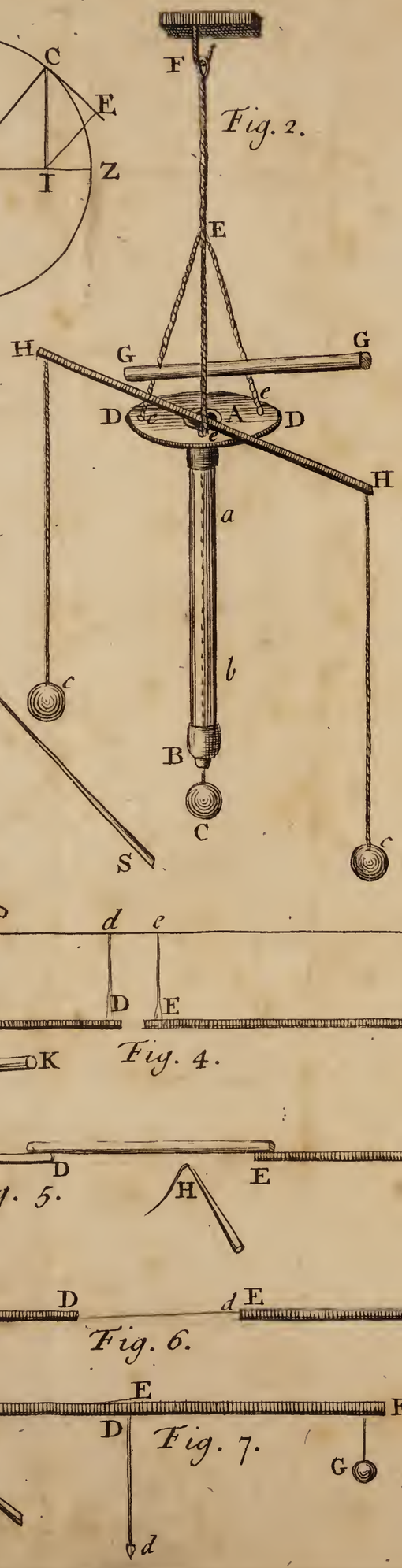
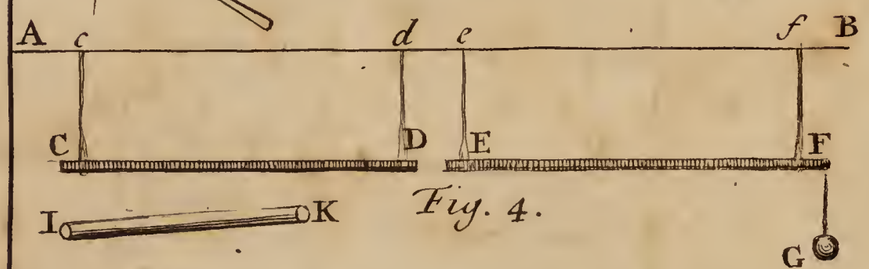


Fig. 3.

Fig. 4.



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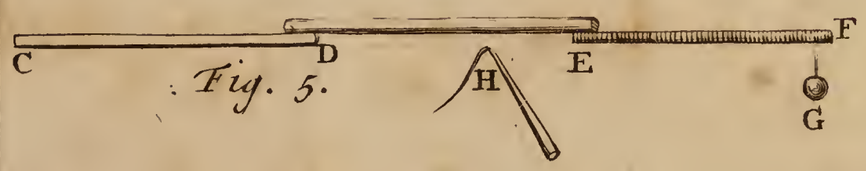

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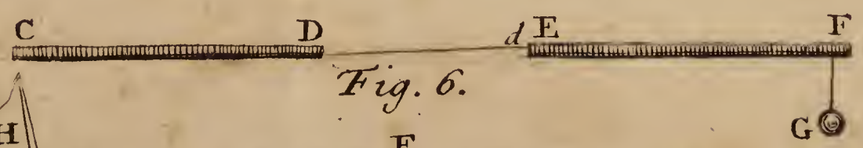

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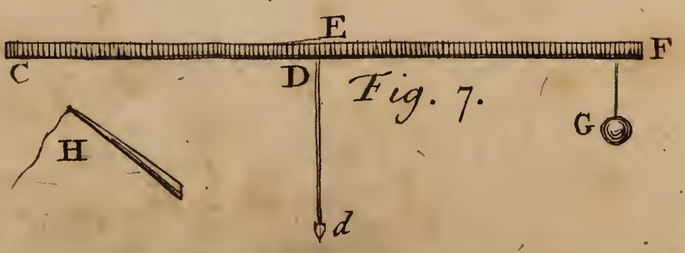

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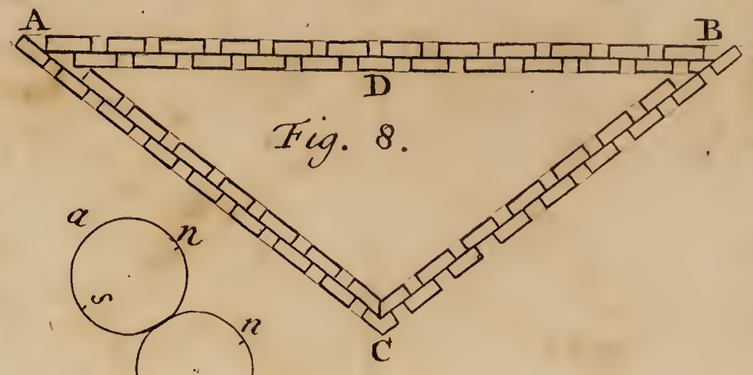
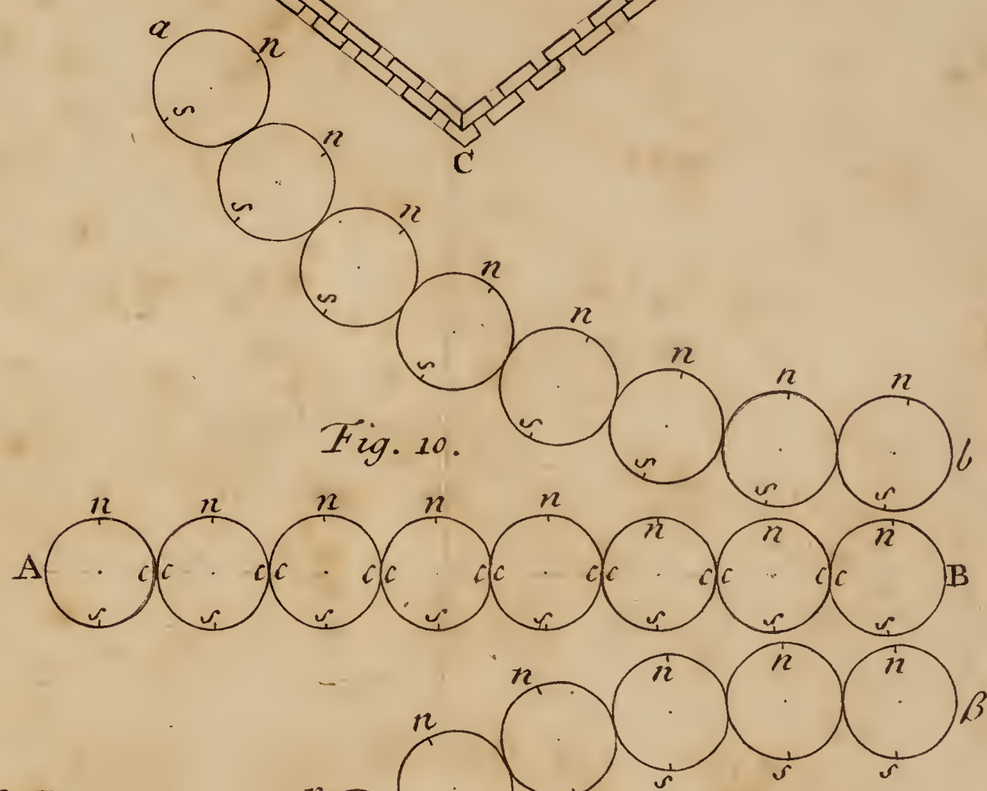


Fig. 9.

Fig. 10.



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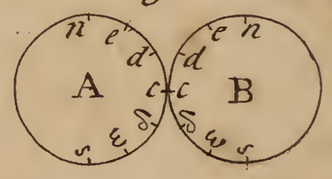

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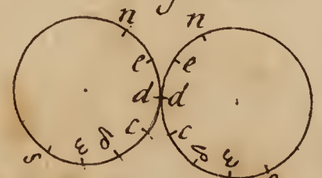

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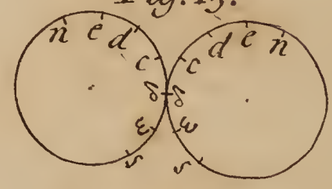


Fig. 14.

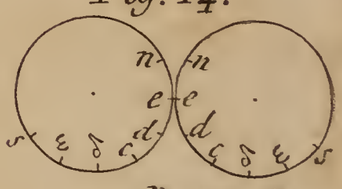


Fig. 15.

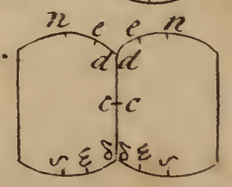


Fig. 16.

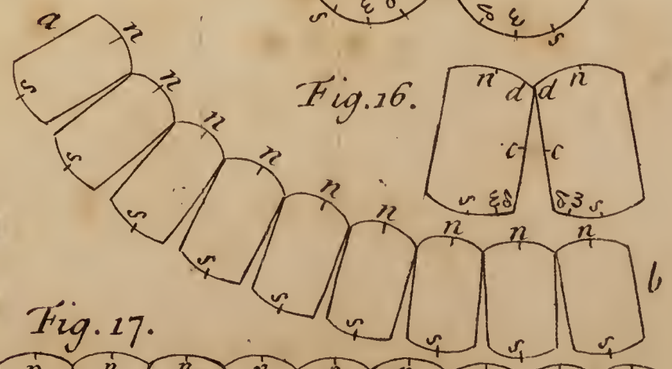


Fig. 17.

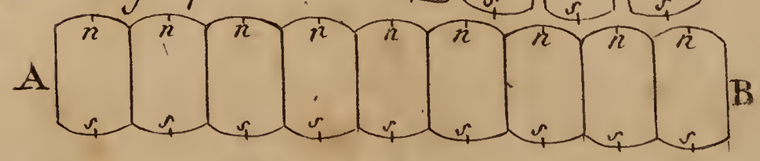


Fig. 18.

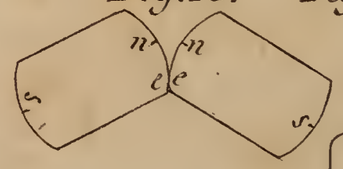
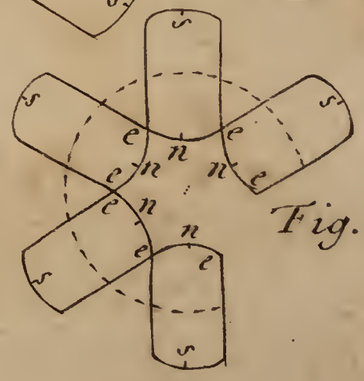


Fig. 19.



Rod, or Tube S T, either hollow or ſolid, made of any Materials whatſoever, thereby fixing it to the Tube T P. The Rod S T may be taken off, in order to put in it's ſtead a larger or leſſer, as Occaſion requires. S is a Star at the Top of the Rod ST, which ſerves as an Index, pointing to the graduated Scale L A, which is fixed to the Cover of the Veſſel A B C D. M N is a large Cylindrical Tube made of Tin (repreſented ſeparately at *m n)* which receives in it's Cavity the ſmaller Part of the Tube T P, and is well cemented to it at both Ends, that none of the Fluid can get in.

the Rev. Mr John Rowning, *Fellow of* Magdalen-*College in* Cambridge. No. 427. p. 39. Jan. *&c.* 1733. Fig. 20.

The Tube T P, with this *Apparatus*, being filled with *Mercury*, and plunged into the Baſon V, which hangs by two or more Wires upon the lower End of the Tube M N, muſt be ſo poiſed as to float in the Liquor contained in the Veſſel A B C D, and then it will riſe when the Atmoſphere becomes lighter, and *è contrà.*

Let the ſpecifick Gravity of Quickſilver be to that of Water, or to the Liquor the Barometer floats in, as *s* to 1 : And if it be propoſed that the Variations of this Compound Barometer ſhall be to the contemporary Variations of the common Barometer in the given Ratio of *n* to 1, this Effect will be obtained by making the Diameter of the Rod S T to the Diameter of the Cavity of the Tube H I, as $\sqrt{\frac{n + s}{n\ s}}$ to 1, which may be thus demonſtrated.

Let us ſuppoſe that the Variation of the Height of the Quickſilver in the common Barometer, called *v*, is ſuch, that a Cubic Inch of Quickſilver ſhall riſe into the Vacuum X T ; in order to which a Cubic Inch of Quickſilver muſt riſe from the Veſſel V, that is, the Surface P muſt ſubſide ſo far, that a Cubic Inch of Water (if that be the Fluid made uſe of) ſhall enter the Veſſel V, by which Means the Barometer with the Parts annexed will be heavier by a Cubic Inch of the Fluid.

Now this additional Weight of a Cubic Inch of Fluid will make the whole Barometer ſubſide (according to the Laws of Hydroſtaticks) 'till a Cubic Inch of the Rod H S, immediately extant above the Surface at W, ſhall come under it ; but the Length of ſuch a Magnitude of H S will exceed the Length of an equal Magnitude of Quickſilver in the larger Tube X, as much as the Square of the Diameter at X exceeds the Square of the Diameter at H (the Lengths of equal Cylinders being reciprocal to their Baſes). That is, the perpendicular Deſcent of the compound Barometer will be to *v*, the perpendicular Aſcent of the Mercury in the common Barometer, as *d* to 1 (ſuppoſing this the Ratio of the Baſes) and conſequently will be equal to *d v*.

But by this Deſcent, the Diſtance P W between the Surface of the ſtagnant Quickſilver and the Top of the Fluid will be augmented by a Column, whoſe Height is *d v*, the Deſcent of the Compound Barometer ; and conſequently the Weight of the whole Column of the Fluid preſſing on the lower Surface of the Quickſilver (to which the Height X

is

is partly owing) will be increaſed by a Column of that Length, and this Increaſe, would produce a ſecond Aſcent of the Mercury at X equal to itſelf, namely $d\,v$, were the Fluid as heavy as Quickſilver; but ſince it is ſuppoſed to be lighter in the Ratio of s to 1, the Aſcent of the Mercury on this Account will only be $\frac{d\,v}{s}$.

But now, as in the former Caſe, when the Aſcent of the Mercury was v, the Deſcent of the Compound Barometer was ſhown to be $d\,v$, ſo here the Aſcent of the Mercury being $\frac{d\,v}{s}$, the Deſcent of the Compound Barometer will be $\frac{d\,d\,v}{s}$, and the next Deſcent $\frac{d\,d\,d\,v}{s\,s}$ and the next $\frac{d^4\,v}{s^3}$, and ſo on to Infinity. Therefore the whole Deſcent of the Compound Barometer, is to the Aſcent of the Mercury in the common Barometer, that is, n is to 1, as $d + \frac{d\,d}{s} + \frac{d\,d\,d}{s\,s} + \frac{d^4}{s^3} +$, &c. to 1, or as $\frac{d\,s}{s-d}$ to 1; becauſe the Terms of the Series being in Geometrical Progreſſion, the Sum of them all is $\frac{d\,s}{s-d}$. Hence we have $n = \frac{d\,s}{s-d}$ and $n\,s = d\,s + d\,n$; that is, $1 : d :: n + s : n\,s :: \frac{n+s}{n\,s} : 1$ and $1 : \sqrt{d}$, that is, the Diameter of S T to the Diameter of H I, as $\sqrt{\frac{n+s}{n\,s}}$ to 1. Q. E. D.

Example I. Putting $s = 14$ and $n = 1$, the Variations in each Barometer will be equal, by taking the Diameter of S T to the Diameter of H I as $\sqrt{\frac{15}{14}} : 1$, that is, as 30 to 29 nearly.

Example II. If n be put infinite, the Diameter of S T will be to the Diameter of H I as $\sqrt{\frac{1}{s}}$ to 1, or 1 to $\sqrt{14}$; that is, as 1 to $3\frac{3}{4}$ nearly.

The Bottom of the Veſſel V, and the Ends of the Tubes, ought to be made rather round than flat for their more eaſy Motion up and down in the Fluid.

It

It will be convenient to have a ſmall Baſon fixed upon the Star, to contain Shot for the more eaſy poiſing the Barometer in the Fluid.

VII. The Eſſay conſiſts of 3 Chapters; the firſt is wholly Mathematical, containing a new Theory concerning the Propagation of tremulous Vibrations along a Series of contiguous elaſtic Bodies. The ſecond applies this Theory to the Solution of the chief Appearances of the Baroſcope, and the laſt explains the ſeveral States or Conſtitutions of the Air and Weather connected with them.

To give a clearer and fuller Apprehenſion of this Matter, our Author thinks it neceſſary to alter the common Definition of Elaſticity, and uſe the following new Terms: The natural Equilibrium of an Elaſtic Body; it's violent Equilibrium; and the Line of a tremulous Vibration.

By the *natural Equilibrium* of an Elaſtic Body, Mr *Gerſten* means the external Figure and Extenſion, which an Elaſtic Body naturally has, when free from all external Preſſure. By a *violent Equilibrium*, he underſtands that State or Degree of Expanſion which an Elaſtick Body is kept in by ſome external compreſſing Force; and he calls that the *Line of a tremulous Vibration*, which a Point taken at Pleaſure in an Elaſtic Body deſcribes during the Vibration.

I paſs over, for Brevity ſake, the Corollaries drawn from his Definition of Elaſticity concerning the Acceleration and Retardation of a Vibration, as alſo the Deſcription and Uſe of an Inſtrument contrived to prove the Truth of what he had advanced; nor ſhall I take any particular Notice of *Prop.* III, IV, V, and VI, wherein he treats of the Velocity of the Elaſtic Bodies in their tremulous Vibration, of the Motion of ſtretched Strings, and their iſochronal Vibrations.

In *Prop.* X he demonſtrates, that ſuppoſing three Elaſtic Bodies to be detained in a *violent Equilibrium* in the ſame Line of tremulous Vibration, if the middle be farther compreſſed on all Sides, ſo as ſtill to remain contiguous to the neighbouring Bodies, it may be reſtored, by tremulous Vibrations, to a greater Extenſion than it had before. He then ſhews the ſame to be true, ſuppoſing the elaſtic Body be placed between ſeveral other homogeneous elaſtic Bodies, in the State of a *violent Equilibrium*. For the Uſe and Application of all this, he refers us to the third Chapter.

The XI and XII *Propoſitions* deſerve particular Regard: In the former he deſcribes a *Machine*, by which any curious Perſon may enquire into the Phænomena and Laws of the Propagation of a tremulous Motion: In the latter he explains and demonſtrates the Theory of thoſe Propagations, found out by the help of this Machine. The Subſtance of them is this.

Suppoſe a Series of elaſtic Globules or Rings, *a*, *b*, *c*, *&c.* in the Line of a *tremulous Vibration* A B, to be kept in a *violent Equilibrium*, an Obſtacle being placed at A and B. Let us ſuppoſe alſo, the laſt Fig. 21.

Ring

An Account of a Book intituled Chriſtiani Ludov. Gerſten Tentamina Syſtematis novi ad mutationes *Barometri* ex natura elateris aërei demonſtrandas, cui adjecta ſub finem, Diſſertatio Roris decidui errorem antiquum & vulgarem per obſervationes & experimenta nova excutiens. Francofurti 1733. in 8*vo*. *Ibid.* p. 43.

Ring *a* to be compreſſed farther towards A, *&c.* ſo as that the Space left in the Line of Vibration may be taken up by the others.

Theſe Things being ſuppoſed, the Author aſſerts, that by the Reſtitution of the compreſſed Ring *a*, the Force impreſſed will be propagated through the other Rings by an individual Action, *i. e.* the Ring *a* in reſtoring itſelf will firſt act only upon *b*, and compreſs it by the Difference of the Forces. Then *b* being compreſſed, will transfer the Force it receives, not backwards, but into the Ring *c*, by an individual Action, and compreſs it likewiſe in Proportion to the Difference of the Forces, and ſo on in the other Rings. So that the Compreſſion of the laſt Ring or Body is to be looked upon as it were like a Subſtance or Body put into Motion, which continues in Motion, 'till it meets with ſomething elſe, that makes an equal or ſufficient Reſiſtance.

From the Whole Mr *Gerſten* draws this material Propoſition, that the Body *a* may after this manner acquire, by repeated Vibrations, a greater Expanſion in the Line A B, than it had before, provided the Series be long enough, ſo that the Force impreſſed may not be ſoon reflected. This Matter is treated of more at large in the following Propoſitions, to the end of the Chapter.

The *ſecond Chapter* is an *Application* of the *Theory* delivered, to the Solution of the Phænomena of the Barometer, after the following manner. The Particles of Air, ſays Mr *Gerſten*, however unknown in other reſpects, are very well known to be capable of receiving and propagating tremulous Vibrations: From hence it follows, as alſo from ſome Principles of Sir *I. Newton*, that the Air *(as in Prop.* V*)* may be dilated by repeated tremulous Vibrations; and by *Prop.* VI, theſe Vibrations may be generated or produced by a confuſed Motion of the Particles of the Air, or by the Agitation of a Wind.

The Author in *Prop.* VII and VIII, undertakes to demonſtrate, that the Dilatation produced by the Motion of a Wind, is leſs when the ambient Air has a Motion the ſame Way, than if the Wind moved with the ſame ſenſible Velocity againſt the quieſcent Atmoſphere; but that this Dilatation would be greater, if the Atmoſphere had a Flux or Current in a Direction contrary to that of the Wind.

Mr *Gerſten* demonſtrates in the next *Propoſition*, that a perpetual *Eaſterly Wind* will reign in all Places within the Tropics, ariſing from the diurnal Heat; and that this Wind will diffuſe itſelf to the other Regions without the Tropics, and have a Direction declining from the Eaſt towards the North or South, according to the Situation of the Region on the terreſtrial Globe; that it's Motion will be more remiſs, the nearer the Places are to either Pole, and that the Angle of Declination from the Eaſt will be greater for the ſame Reaſon.

The preliminary Propoſitions being thus ſettled, he proceeds in *Prop.* XIX, to account for the riſing and falling of the Mercury in the Barometer thus. The Air of the Atmoſphere in our Regions has a natural Motion or Current, whoſe Direction is ſituated between the Eaſt and

and North Points of the Compaſs. If therefore a ſpecial Wind ſhould ſpring up and blow in a contrary Direction, it will produce tremulous Vibrations, and conſequently Dilatations of the Air; then equal Bulks of the dilated Air dilated, will have a leſs Quantity of Matter than before: Therefore the Gravity of the Air will be leſſened, and by Conſequence the Quickſilver in the Weather-Glaſs will fall. And this Decreaſe of Gravity in the Air, and of the Height of the Mercury in the Baroſcope, will be proportional to the Greatneſs of the Force of the Wind and Degree of Oppoſition of it's Direction to that of the Flux of the Atmoſphere conjunctly.

This, ſays Mr *Gerſten*, is the Reaſon why the Mercury falls when Southerly or Weſterly Winds blow, and why the Quickſilver ſinks ſo very low when theſe Winds blow Storm. On the contrary, ſince the Effect ceaſes when the Cauſe is removed, the Height of the Mercury will be greater, the fewer ſpecial Winds there are blowing in a contrary Direction: So that the gentle Winds that blow from the Points of the Compaſs, which lie between the North and the Eaſt, are, as the Author believes, nothing but the natural and univerſal Motion, Current, or Flux of the Atmoſphere impeded by or meeting with very few ſpecial Fluxes. In order to illuſtrate and confirm the Truth of the Demonſtration of this Experiment, he hath in *Schol.* 1. quoted the Experiment of Mr *Hawksbee*, in his *Phyſico-Mechanical Experim. Sect.* V. *Exp.* 5. *pag.* 114. *Edit.* 2.

The Deſign of *Prop.* XX is to prove, that a ſpecial Wind blowing parallel to the Direction of the univerſal, will permit the Mercury to ſtand at a greater Height, than if it had blown in a contrary Direction with the ſame Force. This he confirms by three Obſervations of his own in the *Scholium* annexed.

Prop. XXI ſhows why the Deſcents of the Quickſilver are ſucceſſive, and do uſually, as well as regularly, precede the Arrival of the Winds that cauſe them.

Prop. XXII aſſigns the Reaſons why very conſiderable Alterations in the Riſe or Fall of the Mercury are obſerved at the ſame Time in different Places, though they are at a great Diſtance from each other.

In *Prop.* XXIII, he takes into Conſideration what Influence the Heat has on the Variations of the *Baroſcope*, and denies that it cauſes any ſenſible Changes: However, in the *ſecond Scholium* of this Propoſition, he explains by it, why the Limits of the Variations of the Mercury leſſen, as the Places are nearer the *Tropics*.

The *third or laſt Chapter* is taken up in accounting for the various Changes of the Weather connected with, or conſequent upon the Riſe and Fall of the Mercury in the Weather-Glaſs. The ingenious Author beginning with the Original and Manner of forming Vapours, undertakes to ſettle and confirm, upon ſolid Principles, that which Dr *Halley* had long ago communicated to the learned World, upon this Argument.

In *Prop.* VI he makes uſe of the Principle mentioned before, concerning an elaſtic Body, that it reſtores itſelf to a greater Degree of Expanſion than it was in before it's tremulous Vibrations; and endeavours from thence to explain more particularly the Way, that Nature takes in forming and diſtending the Cavities of the vapoury Bubbles, and afterwards emitting or detaching them from the Surface of a Fluid.

Prop. VIII gives an Account of what will happen to Vapours, according to this Theory, when the ſurrounding Air is condenſed, or rather compreſſed by an external Cauſe. Mr *Gerſten* affirms, that in this Caſe it is not poſſible for them to deſcend. In the *Scholium* ſubjoined, he enlarges upon this Subject, and maintains, that the ſame will happen if the Air be condenſed by any internal Cauſe, for Inſtance, Cold.

It was this *Propoſition*, as the Author informs us, that put him upon inquiring more exactly into the Nature of Dews, which by their Fall in a cold or condenſed Air ſeemed to contradict this Part of his Theory. The Reſult of his repeated and laboured Enquiries is a *Diſſertation*, wherein he undertakes to prove, by a Variety of Experiments, that Dews do not fall, as both the Vulgar and Learned believed before, but riſe out of the Earth. Of this we ſhall give a brief Account, as ſoon as we have obſerved, that in *Prop.* IX and X, he conſiders what will happen to Vapours in any external Dilatation of the Air; and in *Prop.* XI, ſhows, that in that Caſe the Clouds are reſolved into Rain; and upon this he deduces, from the two laſt Propoſitions, the Reaſon of the Deſcent of the Mercury in the Barometer in rainy Weather, and, on the contrary, of it's Aſcent in fine Weather.

The Deſign of the Diſſertation annexed, is to enquire into the Nature of Dew, explain it's Original and Kinds.

All Dews, according to our Author's Philoſophy, owe their Original either to Vegetables, or terreſtrial aſcending Exhalations. Such as derive their Origin from Vegetables, he takes to be only Exudations of their Leaves, *&c.* congealed by the Air. Before he enters upon the Proof of theſe Poſitions, he gives us three general Obſervations regarding the Circumſtances that are requiſite, in order to have a plentiful Dew in any Place. As firſt, the Place in the Day-time muſt be expoſed to the Rays of the Sun for a conſiderable Time; for in ſhady Places, or where the Sun ſhines but little, little or no Dew is to be found. There muſt alſo be a conſiderable Difference between the Heat of the Day, and the Cool of the Night; and in the laſt Place, a ſufficient Moiſture in the Earth.

In treating of that Kind of Dew, which is a Secretion or Exudation of a Juice in Vegetables, he obſerves, that ſome Plants furniſh the Spectator with a very entertaining Sight, the little Drops of Dew being diſpoſed after a very regular, not fortuitous Manner, upon the Sur-

faces or Edges of their Leaves. He gives us the Figures of ſome of them in a Plate.

To determine whether this beautiful Diſpoſition of the dewy Particles is owing to a Deſcent from the chilled Air over the Plant, or a Secretion made from the Juices of the Plant itſelf, he covered ſeveral with Glaſſes, or earthen Veſſels, having their Mouths downwards; and yet the next Day Plenty of this Kind of Dew appeared in it's uſual regular Form.

As to the next Species, or common Dew, he produces ſo many, and ſo differently made Experiments, againſt the vulgar Opinion of it's Deſcent, that if they be all true, it ſeems difficult to ſupport it againſt them. I ſhall mention ſome of the principal.

For two Months together, *viz. June* and *July*, in 1728, every Night, ſeveral ſmooth Plates of Braſs were laid upon the bare Ground; and during theſe Experiments, he never obſerved the leaſt Impreſſions or Traces of Dew on the upper Surfaces, whereas the lower were always covered with it. He repeated the ſame Experiments laſt Year, and with the ſame Succeſs, except in one Caſe, where a Plate lying too near ſome *Lavender*, was bedewed a little on that Part of it's Surface, which was next the Plant, the other Part however remaining dry. He alſo ſuſpended theſe Plates by Threads, in an horizontal Situation, and found the Dew ſpread almoſt equally over both Surfaces, at the Height of three, four, or five Feet, at the Diſtance of one Foot and an half, the lower was more bedewed; but at the Heights of one, two, or three Inches, the lower was overſpread with Dew, while the upper had none.

He is ſo impartial as to mention, in *Section* XVI, ſome Experiments which he made, and at firſt View ſeemed to contradict his Theory: For Inſtance, when he uſed convex Bodies, whether round or cylindrical, he found the upper Surface covered with Dew, and that, whether they were laid upon the Ground, or ſuſpended at any Height from it.

This Obſervation is general, and extends to Bodies of this Kind, that are only contiguous, as Heaps of Straw, Hay, or Wool. It is to Obſervations of this Kind, the vulgar Opinion of Dews falling, owes it's Birth and main Support. Mr *Gerſten* therefore propoſes to conſider theſe diſtinctly in another Eſſay: But leaſt any Argument ſhould in the mean time be drawn from them againſt this Hypotheſis of the Aſcent of Dews from the Earth, he oppoſes Experiment to Experiment.

Thus in *Section* XVII he lays upon the Ground a Board two Foot and a half long, eleven Inches broad, and two Inches and a half thick, with a Quarter of a Sheet of Writing-Paper upon it, having about an Inch hanging over one Edge of it.

To ſecure the Paper from being removed out of it's Place by the Wind, he faſtens it with an Awl ſtuck perpendicularly, having a round wooden Handle, and lays a Knife with a cylindric wooden Handle, as an additional Weight. Upon his Return to ſee what Effect the Dew had upon them, he found that the ſmall Part of the Paper, which was

extended over the Edge, was moiſtened with Dew, while the reſt of the Paper, as alſo the upper Surface of the Board, were dry, but the upper Parts of the Handles of the Awl and Knife all wet.

An Experiment ſomething a-kin to this was made with a Glaſs Tube laid horizontally upon a Braſs Plate fourteen Inches ſquare, having about two Inches and a half reaching beyond the Side of the Plate. The Tube was kept from rolling by two Parallelopipeds of Lead. The Event was, the whole Surface of the Tube was bedewed, while the upper Surface of the Plate remained dry.

In *Section* XXI, XXII, we have a Set of Experiments made with concave Veſſels, having their Mouths upwards, and placed at different Elevations above the Earth. In theſe Caſes alſo he found no Dew at the Bottom of their Cavities, nor on the Sides, except within about an Inch near the Brim.

Since Hoar-Froſt is only common Dew congealed, he applied himſelf to make ſome of the ſame Kind of Experiments upon that, with Braſs Plates laid upon the Ground as before. Theſe likewiſe he found covered with this Kind of Froſt below, but free on the upper Superficies, agreeably to his Hypotheſis.

The Author cloſes the Diſſertation with a curious Inquiry into the Nature and Original of *Honey-Dew*. This he takes to be nothing but the Excrements of ſome Inſects which are to be met with, adhering to the lower Superficies of the Leaves of Plants; and appeals to the Evidence of Senſe for a Demonſtration.

Let any inquiſitive Perſon, ſays he, lay a Piece of Paper under any of the Leaves abounding with theſe *Animalcula*, and in a ſmall Space of Time he will find a Liquor, or ſoft Subſtance, the very ſame with what we call *Ros Mellis*, gathered together in good Plenty upon it.

Of the Differences of the Heights of Barometers, by Sam. Chriſtian Hollman. In Regia Georgia Auguſta. Leg. Mat. & Theol. Nat. P. P. O. No. 464. p. 116. *Read* May 20, 1742.

VIII. In *July* 1741, being to take a Journey with our famous *Haller* to the Mountains of our famous *Hercynia*, I prepared among other Things a Barometer, with which I intended to make Experiments as we went along. I had carefully divided the Scale of Aſcent and Deſcent of the Barometer into *Rhinland* Inches and Twelfths, or Lines, from the 20th to the 32d Inch. When I went to apply it to this Barometer, which was newly made, and compared it with 6 others, which I had by me, I found unexpectedly, that none of them exactly agreed in Height, there being a Difference from 2 to 12 Lines between them. I was ſatisfied that there was no Fault in any of them; and yet the new made one, which I had hitherto found to be exceeding good, and very ſenſible, roſe 2 Lines above them. On my Return I began to inquire diligently into the Differences that I had obſerved, and as I found them to be the ſame again, I conſtructed new Barometers, with upright Tubes, but different Apertures. I found again the Differences between theſe to be from 1 to 4 Lines; and thoſe, which roſe the higheſt, exceeded that which I have called my beſt by full 6 Lines. *Aug.* 12. I repeated the ſame Experiments with theſe 15 Barometers, and

and again obſerved nearly the ſame Differences. Therefore I prepared 10 new ones, with upright Tubes, Part of them having bent Glaſs Ciſterns to receive the Quickſilver deſcending from the Tubes, and Part without. Here I obſerved 10 Heights of theſe Barometers to differ from 1 to 1 ½ Line, and to exceed the Height of my beſt Barometer 4 Lines.

It is not neceſſary to mention with how much Circumſpection and Care I conſtructed all theſe Barometers. They were all made after the ſame Manner, and great Care was taken that no Air ſhould remain in the Extremity of the Tubes, or between the Particles of Quickſilver, or ſtick to the Glaſs. The laſt 18 were made with the ſame Quickſilver perfectly purified. But there was ſome Difference among the Glaſs Tubes, which with ſome other Circumſtances muſt not be paſſed over in Silence: For my beſt Barometer, in which the Quickſilver has always the leaſt Height, has a Tube made of green Glaſs, and a ſeparate Ciſtern made of the ſame Glaſs, with ſome Quickſilver in it. I ſhall diſtinguiſh it in Claſs I. under N°. 1; and that which I uſed in the Mountains of *Hercynia*, under N°. 2. But that Tube, in which the Quickſilver roſe higheſt, and often a full *Rhinland* Inch higher than on N°. 1, is made of the whiteſt Glaſs. It is inſerted into a wooden Ciſtern, and has a remarkable *Phoſphorus*; but changes it's Heights more ſlowly than any of the reſt: For I ſuppoſe every body knows, that the Quickſilver does not riſe in all Barometers in the ſame Manner, and with equal Readineſs. I have known it myſelf above theſe 7 Years. I ſhall diſtinguiſh this Barometer under N°. 7: That under N°. 3 is a diagonal one, with a ſingle Bend, and a bent Glaſs Ciſtern adhering underneath. N°. 4 is *Bernoulli*'s, the Tube of which is to the Cylinder faſtened above as 1 to 8. N°. 5 is *Huygens*'s, the Diſagreement of which, as well as of the diagonal ones with the reſt, is not to be wondered at; for the Cauſes of their not agreeing are evident. N°. 6 is another diagonal one, but with a double Bend, one of which is received by that Part of the Tube to which the Scale is applied, intercepting an Angle of about 25°, with the perpendicular Part of the Tube, in the double Angle of which, becauſe of the greater Narrowneſs of the Tube, the Quickſilver muſt of Neceſſity be wonderfully retarded in it's Aſcent and Deſcent.

The Barometers, which I have referred to the ſecond Claſs, have all of them Glaſs Tubes of a different Kind; but the Glaſs is ſubject to one Fault, that when melted at a Lamp, the Surface becomes covered with very ſmall Scales, and loſes Part of it's Tranſparency. And theſe are the Tubes, in which the Quickſilver riſes to the greateſt Height in the upright and ſimple Barometers, excepting only that which produces the *Phoſphorus*.

To the *third* Claſs I have referred thoſe Barometers, which conſiſt of very white Tubes, but ſuffer no Alteration by the Fire, and were prepared in the ſame Glaſs-Houſe at the ſame Time. The Barometers

compoſed

compoſed of theſe were all rectilineal and ſimple. And among theſe I found no greater a difference of Height, than from ½ to 1 ½ Line; and the greateſt Height in theſe did not exceed the leaſt in the others by above 4 Lines, as I mentioned before.

Are we therefore to ſeek the Cauſe of this Difference in the Diverſity of the Glaſs Tubes? Is not the Surface of one more rough and uneven than the Surface of another, and does it not therefore more or leſs reſiſt the Aſcent of the Quickſilver by it's Friction? or is it from any other Cauſe?

I ſhall now give a ſhort Account of my Obſervations.

Claſs I.

Barometers of which the different Heights were obſerved *July* 27. and *Aug.* 12.

	Aperture of the Tube.	Height of the Quickſilver. *Rhinland Foot*
		″ ‴
N°. 1	⅓ Line	27 11
2	½	28 1
3	½	27 11
4		28 4
5		28 5
6	⅓	28 7 ½
7	½	28 9

Claſs II.

8 Barometers new made *July* 27.

	Aperture of the Tube.	Height of the Quickſilver.
		″ ‴
N°. 1	2 ½ Line	28 1 ¼
2	2	28 4
3	1 ⅔	28 4
4	1 ½	28 2 ¼
5	1 ⅓	28 2
6	1 ¼	28 2
7	1	28 2
8	⅔	28 4

Claſs III.

10 Barometers newly conſtructed *Aug.* 12. of which the 5 firſt had no Ciſterns annexed, and the 5 laſt had bent Glaſs Ciſterns annexed underneath, to receive the Quickſilver deſcending from the Tube.

	Aperture of the Tube.	Height of the Quickſilver.
		″ ‴
N°. 1	⅓ Line	27 11 ½
2	⅓	27 11 ½
3	1 ¾	27 11 ½
4	2 ¼	28 0
5	1 ½	27 11 ½
6	1 ⅔	28 0
7	½	28 0
8	1	28 1
9	1 ½	27 11 ½
10	¼	27 11 ½

Therefore ſince different Barometers made at the ſame Time, and in the ſame Place, have different Heights; ought we not to think about *harmonic* Barometers with the ſame Earneſtneſs as about Thermometers, before we can with ſufficient Security collect from the annual Obſervations of Barometers, their mean Heights in different Places,

Places, and thence, among other things, the Elevations of thoſe Places above the Surface of the Sea? According to the Barometer, which I have now uſed for 7 Years, and put in Claſs I. *N.* 1. the mean Height of the Quickſilver here will be = $27^{II}\ 10^{III}$ *Rhinland* Foot; but according to the 2*d*, which I uſed in the Mountains of *Hercynia*, $28^{II}\ 0^{III}$, to which the reſt may be eaſily referred.

But to conclude, I ſhall add only one thing more, which I obſerved with the Barometer on the Metal-bearing Mountains of our *Hercynia*, and on the loftieſt Summit of them, called in German *Der Brocken*, or *Der Brockeſberg*, I went thither *July* 9. when the Barometer juſt now mentioned ſtood here at *Gottinghen* at $28^{II}\ 3^{III}$, but the next Day on the Summit of *Blockſberg* it ſtood at $25^{II}\ 2^{III}$, when in the mean Time the Height was altered only 2 Lines here. Therefore the difference of Height between this Place and the Top of *Blockſberg*, which is the higheſt of all the Mountains in this Neighbourhood, is = $2^{II}\ 11^{III}$, which, according to *Scheuchzer*'s Computation, would anſwer to 2550 *Paris* Feet, or in round Numbers to about 2500: Which Height, tho' it ſeems conſiderable enough to the Inhabitants of this Mountain, yet can by no means be ſet in Competition with the Mountains of *Switzerland*, *France*, and other Countries.

IX. The Barometer I am about to deſcribe, is not different in Form from ſome uſually made, it being of the Diagonal Kind from whence the more minute Alterations are more readily diſcovered: Of this Form many have been made by the late curious Operator Mr *Patrick*, who though he had done ſo much towards the proving the Weight of the Atmoſphere by which the Mercury in the Tube was ſuſtained, he himſelf did not believe it, but run into that Abſurdity of the Funicular Hypotheſis.

The Imperfections of the Common Barometers, and the Improvement made in them, by Mr Cha. Orme *of* Aſhby-de-la-Zouche *in* Leiceſterſhire, *where they are perfected and rectified; with ſome Obſervations, Remarks, and Rules for their Uſe, by* Hen. Beighton, *F. R. S.* No. 448. p. 248. June &c. 1738.

There is an Inconveniency or Imperfection in moſt, if not all, of thoſe Diagonal Barometers; for after ſome time, the various riſing and falling, and Changes of the Weather, of Heat and Cold, the ſmall Particles of Air that have been interſperſed in the Mercury, have got together in a larger Maſs, as they will incline by Attraction, which will ſeparate the Mercury; and that Quantity of Air will be dilated by Heat, and contracted by Cold, ſo as to ſpoil the Deſign thereof.

Beſides, there is ſuch a Coheſion or Attrition of the Mercury to the Tube, (eſpecially in the ſmall ones) that after ſome Time, the Mercury that is not truly cleanſed from it's Droſs, and purged of all it's Air, in remarkable Changes of the Weather will neither riſe nor fall. All which Embarraſſment is taken off, and the Difficulties ſurmounted, in

Mr Cha. Orme's *Improvements of the* Barometer, *by the Method following.*

Firſt, The Quickſilver is all purified from it's Droſs and earthy Particles by Diſtillation; and when the Tube is filled by a Pound and half, two,

two, or three Pounds of Mercury, and all the Air got out by the Methods uſed in filling Tubes, then the remaining Air is got out by ſuch an intenſe Heat of Fire as makes the Mercury boil; by which Ebullition an innumerable Quantity of ſmall Particles are emitted, and blow with a great Velocity at the open End of the Tube, till all the Air is quite cleared out; which curious as well as fatiguing Operation is continued for the Space of four Hours: And when no more Bubbles would riſe in the Tube, it remained whole, with it's Mercury of a moſt lively ſparkling Brightneſs, with this Difference only, that the Mercury, ſo purged from it's Air, did not fill the Tube ſo high as when firſt put in by about two Inches; which is a plain Demonſtration, that in that Tube, which was 49 Inches long, there was interſperſed in the Mercury at firſt filling it, ſo much Air as would fill two Inches of the ſaid Tube, which was a 24th Part of the ſaid Space.

The whole Operation I myſelf attended the 20th of *January*, 1734-5.

And further I can affirm, that every Part of the Mercury boiled for a long Time, and the Tube was *gradatim* ſo red-hot, that with a warm Knife I could make Impreſſions in any Part of it.

And this I the rather mention, by reaſon I have heard ſeveral Perſons, and thoſe not incurious, affirm it was impoſſible.

And that this is the moſt ſure and certain (if not the only) Method for getting out all the Air, may be judged by the boiling of Water, which in it's Ebullition does emit a great Quantity of Air for a long Space of Time.

The Perfection *of theſe* Barometers, *which exceed all others, I have ever obſerved in the following Particulars:*

1. They are ſenſible of the moſt minute Changes of the Air whatſoever.

2. They foretel the Weather by a much longer Space of Time than others, as moſtly 20 Hours, ſometimes 36 or 48 Hours: Nay, before great Tempeſts, and ſuch Rains as cauſe great Floods, for a much longer Time before they happen.

3. Although they are ſo ſenſible of ſuch minute Changes of the Air, yet the moſt intenſe Heat will not raiſe them a Hair's Breadth, nor the greateſt Cold make them fall. This ſhews they are perfect Barometers, and not in any Degree Thermometers.

4. You may by them diſtinguiſh whether, if they ſhew for Rain, it will be little or much.

5. As by other Barometers you cannot tell the Weather, but by a paſt and a preſent Obſervation; theſe tell you the Inſtant of Time you come to them, what the Weather is going to be: For by rapping the Caſe with your Finger, if it is going to be fair, or very fair Weather,

the

the Mercury will riſe that Moment $\frac{1}{10}$ of an Inch, or more: But if for foul, it will ſcarce make any ſenſible Riſe.

I have had one of the Glaſſes by me for 10 Years, and have conſtantly obſerved it's Motions, which has very ſeldom failed me in foretelling any conſiderable Change of the Weather.

But as ſome People have ſuch ſtrange Notions, as not judging afterward whether they were told true or falſe, and others may miſs in their Expectations of perfect Certainties, which none can attain to, it will not be improper to make the following REMARKS.

1. Though you can foretel it will rain on the Morrow, it is impoſſible to tell where that Rain will fall; for as every Shower has Space, *i. e.* Length and Breadth, if it rains in that particular Field, yet it may be fair in the next adjoining: And if in Harveſt, or on a Journey, you proclaim it will rain on the Morrow, ſome will, if it does not fall on their Land, or on his Coat, be ſo ſilly as to ſay the Prediction was falſe. Remarks.

2. The Barometer does only ſhew the Preſſure or Weight of the Atmoſphere, and Inclination of the Air, in and about the Country where it ſtands, and not always in a particular Spot; ſo that in foretelling of great Rains, People are apt to ſay the Indication is falſe, becauſe they have not ſeen or heard of it; when perhaps in a Day or two you will hear, that it did then fall three, four, or may be 10 Miles off: For though the Rain ſhould be over us when the Glaſs fell, yet the Wind carries the Clouds and Rain with it.

3. It is very hard to diſtinguiſh on the Mercury's falling, whether it will be Rain or high Winds, they equally cauſing the Mercury to ſubſide.

4. Of all thoſe who gueſs at the Weather from the Whims of their own Brains, it is obſervable it is not true one Time in ten, nor do any two of them agree about it.

But from Obſervations on this Barometer, it will ſeldom fail you once in 20; ſo it is above 100 to 1 preferable.

5. If from the State of the Mercury Yeſterday and this Morning, it be pronounced the next Day will be no Rain, and I look at the Glaſs no more To-day; perhaps Winds may ariſe, and ſo alter the Atmoſphere's Weight, and the Glaſs falls much, it will rain on the Morrow, contrary to what I at firſt expected. Here it is plain, had I ſeen the Glaſs again in the Afternoon, I might have alſo foreſeen the Rain.

Hence it is evident from theſe Remarks, that Judgments are taken on the Weather from Barometers, which do not prove ſo; and this begets Opinions in the Vulgar and Ignorant, that there is no Judgment at all to be had from them.

If they could conſider, nothing in Nature is certain, permanent, and perfect, neither in ourſelves, or what we do or think; then why do we expect it in the Air? Is it not ſubject to as many Chances, Variations, and Mutations? Or why ſhould we expect a Foreknowledge of it abſo-

lutely from the Barometer, and that it ſhould force us to underſtand it's Meaning infallibly?

If the Barometer could only foretel very great and remarkable Changes of the Weather; for Inſtance, in Harveſt-time, that a very great Rain, or perhaps Floods, were coming, the Huſbandman would ſtop cutting down his Grain, and ſave ſome of it being ſpoiled by the Wet: Or on a Journey, if I know that if I do not get Home by ſuch a Time, or paſs ſuch Rivers, the Floods will be ſo great as not only to prevent me, but endanger my Life: And may be here is a Man's Fortune ſaved, nay his Life, merely from the Indications of the Barometer; and who reckons this nothing, deſerves neither.

Do not we reckon a Memory, or a Hiſtory, good, that calls to Mind, or notes every valuable or remarkable Event, though not every Tale or trifling Story?

The greateſt Storm that has been in our Days, was *Jan.* 8, 1734-5. On the 5th the Mercury began to fall, and on the 8th was $\frac{1}{10}$ below 28 Inches, which has not been ſeen in this Age, or perhaps ſince *Torricellius*'s Time; thence I could plainly indicate, that it would be the greateſt Flood we ever heard of, or the greateſt Storm we ever felt; the latter of which it proved.

Some Rules and Obſervations for foreknowing the Weather, by the riſing and falling of the Mercury.

Though riſing always preſages fair, and falling foul Weather, yet there are ſeveral Difficulties and Niceties in making a true Judgment from them, and herein conſiſts the chief Part of the Art.

I ſhall not trouble you with the ſeveral Obſervations made by Dr *Halley*, Dr *Beal*, Dr *Derham*, Mr *Patrick*, and others, though they are moſt of them applicable to this improved Diagonal Barometer, by reaſon their Eſteem has cauſed them to be in ſo many Hands, and in moſt Authors on the Subject, and becauſe I have collected them in order to be made public, at the Requeſt of the Improver of the Barometer, Mr *Orme*, and for his Uſe; which ſome Time ſince were put into the Hands of Dr *Deſaguliers*, who is acquainted with Mr *Orme* and his Glaſſes. I ſhall only inſert here ſome few Obſervations, which I believe may be called Rules, as I have deduced them from Time to Time, in uſing Mr *Orme*'s Glaſſes, and keeping a Regiſter of the Weather; and ſhall at the End of this Account inſert ſeveral more Obſervations on the Diary of the Weather, now ſent with this, which are not yet digeſted into certain Rules, but may in Time, I preſume, by ſome more ſkilful Perſons; or by a longer Series of Obſervations and Regiſters of the Weather, which I deſign to purſue, if Health continue.

Rules and Obſervations for the improved Diagonal Barometer.

1. This Barometer very rarely foretels Thunder, ſeldom falling at all before it, which Mr *Patrick* obſerves others do.

2. In ſerene and hot Weather, when the Mercury is high and riſing, and you have all the poſſible Certainty of fair Weather the next Day, and if there happen to fall great Showers, you may conclude they have been driven upon you by Thunder, though you have heard nothing of it.

3. When the Mercury is pretty high, and has fallen to foretel Rain, and it riſes again before the Rain cometh, it indicates there will be but little of it.

4. If the Mercury continues falling whilſt it does rain, it ſhews it will rain the next Day.

5. In fair Weather, when the Mercury has continued high or riſing, if it falls a little To-day about Noon, and towards the Evening riſes again, you muſt expect a ſingle Shower the latter Part of the next Day, (or perchance by Noon) and then fair Weather again forward.

6. When the Mercury riſes gradually, (about half a 10th perpendicular) and continues ſo to do for many Days together; you may reaſonably expect a fair Seaſon for as long a Time as it was riſing, unleſs ſome Gales of Wind intervene, and eſpecially the S W by S, or thereabouts.

7. When the Mercury riſes very faſt, or falls very faſt, neither the fair nor foul Weather it forebodes will continue long.

8. Without knowing how the Mercury has ſtood ſome little Time before, a true Judgment cannot be given at all Times: For ſuppoſe I find it in a riſing Condition, I am apt to think it will be fair; but if it had been higher ſome Hours ago, and fell, there muſt happen a Shower.

That the Mercury in the Diagonal Barometer, (if it be for fair Weather) on rapping the Caſe ſeveral Times, which jars and makes the Tube tremble, will riſe at every Stroke for ſeveral Strokes together, and in all ſometimes $\frac{1}{10}$ of an Inch, or more, in the perpendicular, may, I preſume, be thus accounted for:

1. There is a Coheſion of the Mercury to the Tube, which hinders it's riſing, and ſuch rapping releaſes that.

2. But it is obſervable, that it will riſe a little at all Times, even when it is in a ſtanding or even in a falling Condition. This may be accounted for thus:

The Mercury and Atmoſphere are in an *Equilibrium*, and rapping ſtarts and raiſes the Mercury a little in a boiling Manner, eſpecially the upper Surface of it, which is ſeen to leap, or be in a ſwimming Poſture; then the Preſſure of the Atmoſphere over-balances the Remainder of the Mercury, and it muſt riſe a little.

Or ſuch violent Jarring puts the Mercury in a lateral and upward Motion, (for downward it cannot go) which takes off it's Gravity, as the Winds leſſen the Preſſure of the Air; therefore it muſt riſe a little.

But then it is obſervable alſo, that if the Mercury was in a ſtanding Condition, or falling, ſuch riſing as above will in a Minute come to the ſame Place again; and even when the Mercury is in a riſing Condition, it will, in that Space of Time, fall a little Part of that it roſe by ſuch rapping.

This Barometer has the Coruſcations, as they were obſerved in Mr *Patrick*'s pendant one; for by rapping the Caſe with the Finger in a dark Place, it will emit ſeveral bright Flaſhes along the empty Part of the Tube.

This I take to be an Argument that the *Vacuum* is very pure, and the Mercury truly purged.

Collections from the Diary of the Weather and Barometer, in order to ſettle Rules for foretelling the Weather by the Barometer.

Before great Storms the Mercury falls 3 or 4 Days, and is exceeding low.

1734-5, *Jan.* 4. at Night the Mercury at 29.92 Inches.
5. Night — — — — 29.66
6. Night — — — — 29.2
7. Night — — — — 28.1
8. Noon — — — — 27.9 Lower than has been known by $\frac{1}{10}$, and the greateſt Storm of Wind ever heard of in this Age, in the South of *England*, as alſo in *France* and *Holland*.

1736. *Jan.* 31. — — — — 29.47
Feb. 1. — — — — 29.15
2. — — — — 28.39 Rain and ſtormy.
1734. *Aug.* 11. — — — — — — Stormy.

Before great Floods the Mercury falls very much.

1735. *Sept.* 4. — — — — — 29.7
5. — — — — — 29.6
6. Night — — — — 29.6
7. — — — — — 29.25 The greateſt Flood that has been (at *Coventry*, being about the Middle of *England*) theſe 40 Years, and yet the Mercury fell but little.

1735. *Oct.* 23. — — — — — 29.55
24. Night — — — 28.8
25. Night — — — — 28.78
26. — — — — — 28.85
27. — — — — — 28.26 A great Flood.
1735. *Aug.* 19. — — — — 29.3
20. — — — — — 29.28
21. — — — — 29.3
22. — — — — — 29.2
23. — — — — — 29.2 Stormy, great Rain.
24. — — — — 29.38 Floods.
1735. *Dec.* 2. — — — — 29.32 Rain.
3. — — — — — 29.5 Fair.
4. — — — — — 28.8 Rain.
5. — — — — — 28.9 Rain.
6. — — — — — 29.5 Fair.
7. — — — — — 29.52 Great Rains and Floods.

The

The Mercury ſeldom falls for Rains that come by Thunder. See Diary, *June* 2, 1735.

When the Mercury did riſe.

1733. *June*	21.	29.16	29.56
	22.	29.56	29.56
	23.	29.62	29.65 Hot.
	24.	29.65	29.57 Sultry.
	25.	29.54	29.52 Sultry.
	26.	29.51	29.59 Great Thunder.
	27.	29.57	29.56 A very violent Thunder, from ten in the Morning to one in the Afternoon, doing great Damages.
1735. *June*	1.	29.3	29.8
	2.	29.4	29.55 Thunder and great Rains.

The Mercury fell before Thunder.

1733. *July*	27.	29.44	Hot, fair.
	28.	29.37	Wind, Rain.
	29.	29.09	Violent Thunder.
1734. *Aug.*	7.	29.59	Sultry.
	8.	29.46	Fair.
	9.	29.25	Thunder.
	10.	28.87	Rain, Thunder.

A Froſt, when the Mercury is high, brings Rain.

1731, *March.* The Mercury was high all the Month, and no Rain, but what followed the Froſt on the 17th and 29th.

Dry Seaſon in *June* 1729, and the Mercury ſcarce ever above changeable.

In *Aug.* 1730, the Mercury never lower than 29.37.

1731, from the 1ſt to the 10th, and Rain came the 16th, though the Mercury was riſing.

A great Froſt, although the Mercury fell; but it was attended with a great Snow, which might occaſion it to ſubſide.

1731, *Jan.*	1.	29.56	Rain.
	2.	29.46	29.12 Rain.
	3.	28.78	28.72 Wind.
	4.	28.72	28.81 Froſt, great Snow.
	5.	28.93	29.12 Snow, Froſt, Great

Great Rains, although the Mercury was rising.

1732. *May*	1.	29.28	29.25	Wind.
	2.	29.21	29.25	Rain all Day, Snow hard from 8 to 11.
	3.	29.34	29.0	Rain.
	4.	29.09	29.09	Rain.
	5.	29.12	29.34	Wind.
	6.	29.44	29.46	Fair.
	7.	29.52	29.39	Rain and great Floods.

Great Rain, though the Mercury fell but little.

1733.	24.	29.6	29.54	Wind.
	25.	29.51	29.54	Fair.
	26.	29.52	29.54	Fair.
	27.	29.5	29.39	Violent Rain for more than 11 Hours.

Great Rains, the Mercury falling very much.

1734. *July*	10.	29.65	29.67	Fair, hot.
	11.	29.63	29.62	Fair, hot.
	12.	29.59	29.4	Rain.
	13.	29.29	29.13	Great Rains.

—— The Mercury falling a great while before the Rain came, and the Rain continued as long.

1736. *May*	19.	29.75	Fair, Wind,	29.8
	20.	29.8	Cold Wind, fair,	29.7
	21.	29.65	Cold Wind,	29.52
	22.	29.39	Wind, Clouds, Rain,	29.31
⊙	23.	29.28	Cloudy, fair	29.27
	24.	29.32	Fair,	29.35
	25.	29.32	Cloudy, Wind, Rain	29.24
	26.	29.15	Rain,	29.15
	27.	29.12	Rain,	29.2
	28.	29.28	Rain,	29.23
	29.	29.37	Wind, cloudy, Rain.	
1735. *Feb.*	22.	29.43		
	23.	28.82		
	24.	28.9		
	25.	28.76	Great Rain.	

Juſt after hot or ſultry Weather, the Mercury generally falls.

See 16 *Sept.* 1731.
8 *Aug.* 1734.

After

After the *Aurora Borealis*, there generally follow high Winds.

27 *Oct.* 1733. a large *Aurora Borealis*, and the 28th, 29th and 30th high Winds.
See 23 *Jan.* 1734.

The Mercury falling pretty much, and neither Wind nor Rain ſucceeded.
1733, from the 18th to the 21ſt it fell 41, and no Wind or Rain at all till the 25th.

Sultry Weather generally makes the Mercury fall ſoon after.
1734. *Aug.* 8.

After a great Storm the Mercury riſes very faſt.
1734. *Aug.* 11.
1736. *Feb.* 6.

Before great Winds the Mercury falls very ſoon.
1734. *Aug.* 26.
1736. *Feb.* 8.

The Mercury below 28 Inches.
1734. *Dec.* 15. at 27.9
1735. *Jan.* 8. 27.9

In Winter, before Froſts, the Mercury generally riſes pretty faſt.
1735. *Dec.* 12.

Before a Thaw the Mercury falls.
1735. *Dec.* 13.
17.
1736. *Feb.* 9.

The Mercury falls ſuddenly before a great Snow,
1731. *Jan.* 4.
1736. *Feb.* 8.
21.

When the Mercury falls for high Winds, and it continues to fall when that Wind is come, it is likely to be tempeſtuous, or continue ſome time, unleſs Rain ſucceeds.

1736. 22. *Nov.*	29.62	fair, warm	29.62		
23.	29.49	windy, warm	29.32	Wind.	
24.	29.1	high Wind	28.88	28.73	Stormy.

Some of theſe Collections are quite contradictory to any ſettled Rules, and ſuch will happen, and others confirm them; but I have collected ſo very few of a Sort, though the Diary furniſhes a great many, that till more are in this manner collected, it will be very doubtful to form any

Rules

Rules from them: As Opportunity gives leave, I intend to collect many more.

The Deſcription and Manner of uſing an Inſtrument for meaſuring the Degrees of the Expanſion of Metals by Heat. By Mr John Ellicott. No. 443. p. 297. Oct. 1736.

Fig. 22.

X. A A is a flat Plate of Braſs, which, for farther Strength, is ſcrewed down to a thick Piece of Mahogany: Upon this Plate are ſcrewed 3 Pieces of Braſs, 2 of which, marked B B, ſerve as Supports for the flat Iron Bar C; and which, on account of it's Uſe, I ſhall call the *Standard Bar*. The upper Part of the third Piece of Braſs is a Circle about 3 Inches Diameter, divided into 360 equal Parts or Degrees: Within this Circle is a moveable Plate, divided likewiſe into 360 Parts, and a ſmall Steel Index. The Braſs Circle is marked D, and the moveable Plate *d*. Upon the Standard Bar the Bar of Metal is laid, on which the Experiment is to be made, as E.

F is a Leaver 2 $\frac{1}{2}$ Inches in length, faſtened to an Axis, which turns in 2 Pieces of Braſs ſcrewed to one of the Supports marked B: To the End of this Leaver is faſtened a Chain, or Silk Line, which, after being wound round a ſmall Cylinder, to which the Index in the Braſs Circle D is faſtened, paſſes over a Pulley, and has a Weight hung to the End of it: Upon the Axis, to which the Leaver is fixed, is a Pulley, $\frac{1}{4}$ of an Inch Diameter, to which a Piece of Watch-chain is faſtened; the other End of this Chain is hooked to a ſtrong Spring, marked G, which Spring bears againſt one End of the Metal E.

H is a Leaver exactly of the ſame Form and Dimenſions with the former; but the Chain faſtened to the Pulley on it's Axis is hooked to the Standard Bar *. The Line faſtened to the End of this Leaver, after being wound round a Cylinder, to which the moveable Plate is fixed, paſſes over a ſmall Pulley, and has a Weight hung to the End of it; or rather the ſame Line paſſing under a Pulley, to which the Weight is hung, has it's other End faſtened to the Leaver F: Thus one Weight ſerves for both Leavers, as in the *Figure*.

From this Deſcription it is plain, that whenever the Bar E is lengthened, it gives Liberty to the Weight to draw the Leaver F upwards by it's Action on the Spring G; and the Index will, at the ſame time, by Means of the Silk Line, be carried forward in the Circle; and as the Bar ſhortens, it will return back again; the ſame Motion will be communicated to the Standard Bar.

The Lengthening the Bar the $\frac{1}{200}$ of an Inch, will carry the Index once round the Braſs Circle, which is divided into 360 Degrees; therefore, if the Metal lengthens the 7200th Part of an Inch, the Index will move one Degree.

To make an Experiment with this Inſtrument, lay a Bar of any kind of Metal, as E, on the Standard Bar; then heat the Standard Bar to any Degree of Heat with a Lamp, and mark the Degree of it's Expanſion as marked by the moveable Plate: Obſerve alſo the Degree of Ex-

* *N. B.* The Chain to the former Pulley being faſtened to a Spring, and not directly to the Metal E, is only for the more eaſy ſhifting the Metals.

panſion

panſion of the Metal E, by the Heat communicated to it from the Standard Bar, as marked on the Braſs Circle by the Index: Let the Inſtrument ſtand, till the whole is thoroughly cold; then removing the Bar E, lay a Bar of any other Metal in it's Place, and heat the Standard Bar to the ſame Degree of Heat as before, which is ſeen by the moveable Plates marking the ſame Degree of Expanſion. Then the Index will ſhew the Degree of Expanſion of the ſecond Metal, as it did of the firſt; and, by this Means, the Degrees of Expanſion of different Metals by the ſame Degree of Heat, may be exactly eſtimated.

An Experiment concerning the nitrous Particles in the Air; by the late Rev. John Clayton *D. D* No. 452. p. 62. Jan. &c. 1739.

XI. I took a ſmall Gally-pot, ſuch as the Apothecaries in the North of *England* make uſe of, where I was when I made this Experiment, and ground the Top of it very ſmooth and true, and adapted thereto a Cover of blue Slate, which I had likewiſe ground with much Care. Into this Gally-pot I put equal Quantities of Nitre and Flour of Sulphur, about a Dram of each. I then fixed on the Cover, putting it into a new Digeſter; but the Height which I raiſed the Heat to, and how long I continued it, I do not exactly remember, but believe it was three or four Seconds. When I opened it the Day following, I perceived ſomething had tranſpired betwixt the Top of the Gally-pot and the Cover; the top Edges of the Gally-pot, where the Glazing was ground off, being diſcoloured, though the Nitre and Sulphur were very little diminiſhed as to their Weight; only they were melted into one Lump, which I took out of the Gally-pot.

And having ſet the empty Gally-pot upon a Shelf, upon looking at it the next Day, I found long hoary Hairs, very bright and brittle, all around the ground Edges of the Pot, very ſpecious to behold. After I had admired them a while, I gathered them, and, taſting them, found them to be pure Nitre. I then ſet the Pot upon the Shelf again, and in 3 or 4 Days, ſtill finding there were freſh Shoots made, as large and ſpecious as at the firſt, I gathered them a ſecond and third time; ſo that I ſuppoſe the Pot would have continued to have ſhot freſh Nitre much longer, if I had not had urgent Uſe for it, to make other Experiments in. However, it is to be obſerved, that I had already gathered more Nitre than I put into the Pot at firſt; though, as I ſaid before, for what I could perceive, I had taken all or near all the Nitre that I firſt put in together with the Sulphur, out of the Pot in a Lump. Hence we may have ſome Conceptions of the Nature of mineral Earths, and how they grow and increaſe, when once impregnated with the Seeds of a Mineral. This likewiſe is a Proof of the Quantity of nitrous Particles with which the Air abounds, ſince the large Quantity of Nitre which I collected out of the Pot, when left empty upon the Shelf, could be ſupplied by the Air only.

An Experiment to prove, that Water, when agitated by Fire, is in-

XII. Sir *Thomas Proby* having heard of a new Digeſter, which I contrived, had a Deſire to ſee it, and ſome Experiments made therein. I had a ſmall one, which I deſigned only for an inward Cylinder; this I could eaſily put in my Pocket: Wherefore, going to pay him a Viſit at

ſinitely more elaſtic than Air in the ſame Circumſtances. By the ſame. No. 454. p. 162.

Elton in *Huntingdonſhire*, I took it along with me; and having ſoftened a Bone therein in a very ſhort Space, he was deſirous to know the ſhorteſt Time it was poſſible to ſoften a Bone in: I told him, I thought I could ſoften the Marrow-bone of an Ox in a very few Minutes, but that that Veſſel was very weak, and I feared would not endure the Preſſure of ſo violent a Heat; yet ſeeming deſirous to have the Experiment tried, I ſaid I was ready to venture my Veſſel: Then having fixed all things right, and included about a Pint of Water, and, I believe, about ℥ij of a Marrow bone, we placed the Veſſel horizontally betwixt the Bars of the Iron Grate into the Fire about half way; and in three Minutes time I found it raiſed to a great Heat; whereupon I had a mind to have taken it out of the Fire, leaſt it ſhould have burſt; telling Sir *Thomas* of the Danger that I apprehended: For I remembered, that the Screws of a Digeſter, made after Mr *Papine*'s Method, giving way, the Head flew one way and the Screwe and Irons another, with ſuch Violence, that the Head, having hit againſt a Brick, cut a Piece clearly out of it; which was one Reaſon and Motive to my contriving a Digeſter this way, that the Screws cannot poſſibly ſtart, but that the Veſſel would ſooner break in any other Part: But in this (I added) I thought the Bottom would firſt burſt, it being only ſoldered in. Scarce had I done ſpeaking, and Sir *Thomas* thereupon moved his Chair to avoid Danger; but ſeeing the Heat become more raging, I ſtepped to the Side-table for the Iron where-with I managed the Digeſter, in order to take it out of the Fire, when, on a ſudden, it burſt as if a Muſquet had gone off. A Maid that was gone a milking, heard it at a conſiderable Diſtance; the Servants ſaid it ſhook the Houſe. As I had foretold, the Bottom of the Veſſel, that was in the Fire, gave way; the Blaſt of the expanded Water blew all the Coals out of the Fire all over the Room; for the Back of the Fire-range was made juſt like an Oven, ſo that circulating therein, it brought forth all the Coals at the Mouth thereof. All the Veſſel together flew in a direct Line croſs the Room, and hitting the Leaf on a Table made of an inch Oak plank, broke it all in Pieces, and rebounded half way of the Room back again. What ſurpriſed me in this Event, was, that the Noiſe it made at it's burſting was by no means like the ſucceſſive evaporating of an Æolipile, but like the firing off of Gunpowder. Nor could I perceive any where in the Room the leaſt Sign of Water, though I looked carefully for it, and, as I ſaid before, I had put a Pint into the Digeſter, ſave only that the Fire was quite extinguiſhed, and every Coal belonging to it was black in an Inſtant.

But to confirm the Elaſticity of Water, or to ſhew, at leaſt, that there is a much ſtronger elaſtic Force in Water and Air, when jointly included in a Veſſel, than when Air alone is incloſed therein, I made the following Experiment: I took two ℥vj Phials, into the one I put about ℥v of Water, or better, and ſo corked it as well as I poſſibly could; the other I corked in the ſame Manner, without putting any thing into it. I incloſed them both in my new Digeſter, ⅔ being filled with Water;

when

when the Heat was raiſed to about five Seconds, I heard a conſiderable Exploſion, and a jingling of Glaſs within the Veſſel, and ſhortly after another Exploſion, but not ſo loud as the former; whence I concluded, that both the Phials were broken. I then let the Digeſter cool leiſurely, and the next Day I opened it; both the Corks were ſwimming on the Top of the Water, but only one of the Phials was broken, *viz.* that one into which I had not put any Water. At firſt, indeed, I concluded, that the Preſſure or Dilatation of the Air in the empty Phial being ſtronger than the ambient Preſſure, forced forth the Cork, whereupon the Water, ruſhing in with Violence, might break the Phial; and therefore that this was the Cauſe alſo of the Loudneſs of the Exploſion; whereas the other being moſtly filled with Water, there being but a ſmall Quantity of Air therein, juſt enough to force out the Cork, the Phial was not broken, but was preſerved by the Force of the Water incloſed therein. But I have had Reaſon ſince to change my Opinion; for having had very ſtrong Phials made, on Purpoſe to make ſome peculiar Experiments therewith, I took one of them, and having filled it about $\frac{1}{4}$ full with Water, and corked it very well, I ſet it in a ſquare Iron Frame, with a Screw to ſcrew down the Cork, and keep it from flying forth. I then put it into a Digeſter, $\frac{2}{3}$ filled with Water; which being heated to a due Height, when I opened it, I found the Cork forced into the Phial, though the Cork was ſo very large, that it amazed ſeveral who ſaw it, to conceive how it was poſſible for ſo large a Cork to be forced into the Bottle. Hence it manifeſtly appears, that the Preſſure in the Digeſter, wherein was proportionately more Water, and leſs Air, was ſtronger than the Preſſure within the Phial, wherein was proportionately more Air, and leſs Water. Then I reaſoned thus alſo of the two former Phials: That the Air in the Phial, wherein was no Water included, making not a proportionate Reſiſtance to the ambient Preſſure in the Digeſter, wherein was a conſiderable Quantity of Water, the Cork was forced inward with ſuch Violence, that it, together with the Water, daſhed the Phial in pieces; but that in the other Phial, wherein there were $\frac{5}{6}$ of Water, the inward Preſſure in the Phial being greater than the ambient Preſſure in the Digeſter, wherein were but $\frac{2}{3}$ of Water, the Cork was thereby forced outward; and that the ſmall Difference between the proportionate Quantity of Water and Air in the Phial and in the Digeſter, being only as $\frac{4}{5}$ to $\frac{5}{6}$, was the Reaſon not only why the Bottle was not broken, but alſo of the Faintneſs of the Exploſion.

XIII. In order to have more ſure Grounds for my Experiments of Natural Philoſophy in this Country, and that they might be compared with thoſe of other Countries, I applied myſelf this Winter to the Conſtruction of Thermometers of Mercury, regulated by the Expanſion of that Fluid proportionably to it's Bulk. This Expanſion is indeed not very perceptible, conſidering that Dr *Halley* in the Experiments made by him upon it above 40 Years ago*, found that the ſaid Expanſion, by

The Conſtruction of a Quick-ſilver Thermometer, by Mr Joſ. Nic. De l'Iſle, *F. R. S. Dated* Peterſburg, $\frac{6}{17}$ Feb. 1732-3, *con-*

* See Vol. II. Chap. I. §. xv.

taining ſeveral Literary Communications. Tranſlated from the French *by* Phil. Henry Zollman. *F. R. S.* No. 441. p. 221.

the Heat of boiling Water, was no more than $\frac{1}{74}$ Part of the Bulk of Mercury, the Experiment having been tried in the Months of *February* and *March*, when the Weather was cold enough, though it did not freeze.

M. *Amontons*, a Member of the Academy of Sciences at *Paris*, alſo relates in the Memoirs of that Academy of the Year 1704, that this Expanſion of the Mercury, is but $\frac{1}{115}$ Part of it's Bulk from the greateſt Heat to the greateſt Cold that is felt at *Paris*. For my own part I found in the great Cold, we had here this Winter on the $\frac{6}{27}$ *January* laſt in the Morning, that the Bulk of the Mercury was condenſed almoſt $\frac{1}{50}$ Part of the Extent it had in boiling Water. The Cold we had that Day, the Wind being at Eaſt, was one of the ſevereſt that ever was felt here. I ſhall give you a more exact Account of it hereafter, when I have compared my new Thermometers with thoſe ordinary Ones I made uſe of for theſe four or five Years paſt. My new Thermometers of Mercury I had made of a good large Size, and in ſuch Manner that, having divided in each the whole Quantity of Mercury it contains into 100,000 Parts; and having marked the Extent of the Bulk of that Mercury in boiling Water, I can at any time ſee on the Diviſions of theſe Thermometers, by how many Parts the Bulk of the Mercury is condenſed through the preſent Temperature of the Air. And though I have made four of theſe Thermometers, which differ very much as to their Size, and the Quantity of Mercury they contain, yet they agree within a very few of theſe Parts. As pure Mercury is of the ſame Nature every where, nor is liable to any Alteration from being incloſed in a Tube; and as it is probable, that taking it equally purified, it will in different Countries be ſubject to the ſame Expanſion, if expoſed to the ſame Degree of Heat; for this Reaſon I am perſuaded theſe Thermometers may very well ſerve to compare the Temperature of different Countries; the rather, as I found by Experience, that theſe Thermometers may be rendered fit enough to mark ſenſibly the Increaſe, or Diminution of the Bulk of the Mercury, within one or two Parts out of the 100,000 continued in the whole Bulk. This Sort of Thermometers has alſo this advantage, that as they mark the proper Expanſion of the Mercury in each Temperature of Air, they may ſerve to ſhew every Moment the Correction that is to be made in the Height of the Mercury in ſimple Barometers; which will ſerve for reducing them to the Height they would have in an equal Temperature of Air: And one might, for this End, chuſe and agree upon the Heat of boiling Water, as a fixed Term, which, in all appearance, will be the ſame all over the World. If the Royal Society ſhould approve this new Conſtruction of Thermometers, and ſhould order ſome of their Members to make the like, we might hereafter be able exactly to compare the Temperature of *England* with that of this Country, and other Places where the like Thermometers ſhould be made. In order to reap this Advantage from my Experiments, I ſhall communicate to the *Royal Society* all the Obſervations I have made here for theſe four or five Years paſt,

XV.

To fold in between pages 468 and 469.

Obſervations of the Variations of the Needle *and* Weather, *made in a Voyage to* Hudſon's-Bay 1731, *by Capt.* Chriſtopher Middleton.

No. 429. p. 127. *July, &c.* 1733.

Months and Days.	Hours.	Barom. Alt.	Therm. Alt.	Lat. *p. Davis* or Act.	Lat. *per Elton.*	Obſ.	Long.	Need. Variat.	Obſ.	Winds.	Weather.
1731	9									E N E	
June 14	12	30	26	59.17			51.52	17.30		S E	Fair and Cloſe.
	9									S E b E	Ditto.
15	9	32	25½								Fair and Cloſe.
	12	31	25½		59.24	Obſ.	84.58	18		E S E	Ditto.
	9	32	24½							Dit.	Ditto.
16	9	32	24½							E S E	Ditto.
	12	32	24.3	59.30			11.50	19		Dit.	Ditto.
	9	32	24½							Dit.	Ditto.
17	9	31	24							S E b S	Ditto.
	12	31	24½	59 35			15.10	20		Dit.	Ditto,——at 2 ſmall Rain.
	9	31½	24							S b W	Ditto.
18	9	31	24							S W	Cloudy with ſmall Miſt.
	12	30	24	59.29			18.45	21		S W b S	Foggy, with ſmall Rain.
	9	29	23							N N W	Fair and clear, but cloudy.
19	9	31	25							Dit.	Clear, with Clouds.
	12	31	25	58.54	58.52	Obſ.	21.15	21.30		Dit.	Hazy, with ſmall Rain.
	6	30	24							N b E	Fair and Clear.
20	9	30	24	Acc.						S E	Clear, with ſmall Rain.
	12	30	24¼	58.47	58.55	Obſ.	24.11	22		Dit.	Fair and cloudy.
	9	29	24½							S E b S	Foggy, freſh Gales and Rain.
21	9	27	24½							S E	Freſh Gales, with much Rain.
	12	26	24	58.47			29.13	24		Dit.	Ditto.
	9	25	24							Dit.	Little Wind and foggy.
22	9	25	24	Acc.						E S E	Ditto,——with ſmall Rain.
	12	24	23½	58.42	58 47	Obſ.	32.54	26	Obſ.	S E b E	Foggy.
	9	24	23½							E S E	Ditto.
23	9	26½	25							N E b E	Freſh Gales, hazy and miſty.
	12	28	25	58.38			36.55	26		E N E	Ditto.
	9	30	26¼							Dit.	Freſh Gales, with Clouds.
24	9	30	26¾							E S E	Fair, with little Winds.
	12	29	25½	58.37		Obſ.	40.56	27.30		Dit.	Ditto.
	9	28	25½							Dit.	Ditto.
25	9	28	25¾							E b S	Light Winds and fair Weather.
	12	27	25	58 32		Obſ.	43	30	Obſ.	Dit.	Fair and clear.
	9	28	25¾							N N W	Cloudy.
26	9	32	28							W N W	Cloſe.
	12	34	29	57.39			43.17	29		W b N	Hazy.
	9	31	27							S W	Freſh Gales and hazy
27	9	33	28							N W	Foggy.
	12	33	28	58.6			45.10	30		N W b N	Thick and foggy.
	9	31	27							S E	Hazy, with ſmall Rain.
28	9	29	28							S S E	Foggy, with much Rain.
	12	29	29	58.18			47.16	31		S W	Hazy, with ſmall Rain.
	9	32½	29½							W S W	Freſh Gales, with Fogs.
29	9	33	29½							W S W	Little Wind, and hazy.
	12	33	29	58.29			47.41	31		S W	Fair and clear; ſome Rain.
	9	32½	28½							S S W	Foggy and wet.
30	9	30	28½							S b W	Squally
	12	29	28¾	58.53			51.16	33		Dit.	Freſh Gales, and hazy.
	9	28	29½							S W	Freſh Gales, Fogs, and Rain.
July 1	9	27½	30½							W b S	☿ 2½ Deg. above chang. ſtormy.
	12	31	30½	59.49			54.56	34		Weſt	—fell 1 Deg. below chang. mod.
	6	32	30½								—fell. Small Rain, and Hazy.
2	9	32	30							Calm	Calm. Somewhat hazy.
	12	32	28¾	60.16	60.16	Obſ.	55.4	34		Calm	—at a Stand, fair and calm.
	9	32½	29							Dit.	—ſomew. fall. light, and clear.
3	9	33	30							North	Cloſe and grey Weather.
	12	33½	31	60.08			56.22	34		N b E	—continues to fall, clear and cold.
	9	33	30½							North	—riſing a little, fair and clear.
4	9	31	29½							N N W	—riſing, fair with flying Clouds.
	12	30	29	59 33	59.33	Obſ.	58.10	37	Obſ.	N W	—riſing, little Wind, & ſmall Rain.
	9	29	28½							North	Cloſe, little Winds & flying Clouds.
5	9	30	29							N W b N	Light Air, and variable,
	12	31	28½	59.33			58.28	37		Calm	—fallen, fair and clear.
	9	31	28½							Dit.	—at a ſtand, fair Weather.
6	9	31	28½							N N W	—at a ſtand, cloſe and little Winds.
	12	31	29	60.2			58.40	37		N N W	—at a ſtand, little Winds.
	9	31	29							N E	—at a ſtand, cloſe, and cloudy.
7	9	31½	30¼							N N E	—ſome. fall. clear white Clouds.
	12	31	30	60.9			60.22	37.40		Calm	Cloſe and grey Weather.
	9	30½	29						Obſ.	S W	—riſing, little Wind and hazy.
8	9	31	29½							S E	Cloſe and foggy.
	12	31	30	60 29	60.30	Obſ.	61.23	38		N E	Ditto.
	9	31	29							W b N	Ditto.
9	9	34	34							S W b S	—fallen 4 Deg. clear and cold.
	12	34	33½	61.16	61.19	Obſ.	63.57	38	Obſ.	Dit.	Fair, clear, much Ice in ſight.
	9	33	32								—riſing, fair and clear.
10	9	32	32	Acc.						E S E	—riſing, fair and clear.
	12	32	32	61.35	61 25	Obſ.	65.17	40		Dit.	—at a ſtand, fair and clear.
	9	32	32								—ſtands, freſh Gale.
11	9	34	33⅓	Acc.						S E b S	—fallen, freſh Gales with Squalls.
	12	34	33⅓	62	62 4	Obſ.	69 2	41		S E b S	—at a ſtand, freſh Gales.
	9	34	33							Dit.	—at a ſtand, hazy.
12	9	37	32½							Dit.	—fallen, fair.
	12	36	30½		62.33	Obſ.	71.2	43		W S W	—ſomewhat riſing, fair.
	9	35	30							Dit.	—riſing, little Winds, and fair.
13	9	35	29½	Acc.						Dit.	—at a ſtand, fair with calm.
	12	35	30	62.46	62 46	Obſ.	72 6	43		N W	Fair and moderate.
	9	35	30⅓							N W	Fair and clear.
14	9	35	32							Dit.	—at a ſtand, fair and clear.
	12	35	32	62.30		Obſ.	73 33	41		North	—at a ſtand, fair and clear.
	9	35	32							N W b N	Fair, ſerene Weather.
15	9	34½	32	Acc.						South	—ſomewhat fallen, foggy.
	12	35	33½	63.13	63.14	Obſ.	75.9	41		S b E	Very foggy.
	9	35	33½							S E	—at a ſtand, foggy.
16	9	35	33	Acc.						N W	—at a ſtand, fair and clear.
	12	35	32	63.21	62.58	Obſ.	77.3	42		N N W	Fair, ſerene Weather.
	9	35½	31½							Dit.	—falling, clear.
17	9	34½	31							N W	—riſing, clear.
	12	33½	30½	63.17			78.29	41		Dit.	—continues riſing, clear.
	9	33	30½							North	—riſing, ſerene Weather.
18	9	33½	31	Acc.						N W	Foggy.
	12	34	31½	63.9	63.6	Obſ.	79.53	40		Dit.	—a little fallen, thick Fog.
	9	34	31½							South	—at a ſtand, hazy.
19	9	33½	31½							East	—riſing, freſh Gale.
	12	33	30½	62.14		Obſ.	80.44			E b N	—continues riſing, fair and clear.
	9	30½	29							Dit.	—continues riſing, ſerene.
20	9	28	27							Weſt	—riſing, grey cloſe Weather.
	12	28	26½	61.18			81.26	37		Dit.	—ſtands, freſh Gales and foggy.
	9	30	29							N W	—fallen, hazy.
21	9	32	30							North	—falls, fair and clear.
	12	32	29	60.5		Obſ.	83.2	34		N W	—ſtands, freſh Gales, and fair.
	9	32	29½							Dit.	—at a ſtand, ſqually.
22	9	34	31							N W	—fallen, moderate and fair.
	12	34	31	58.4		Obſ.	84.20	30		Weſt	—at a ſtand, fair.
	9	33	31							W S W	—riſes, dark and cloudy.
23	9	32	31							W b N	—riſing, dirty and Rain.
	12	32½	31½	57.35			84.20	29		W b S	—ſtands, foggy, and ſmall Rain.
	9	33	32							N W	—fallen, freſh breeze and cold.
24	9	37	34	Acc.						N W	—fallen 4 Deg. in cloſe white Ice.
	12	37	33½	56.13	56.20	Obſ.	85.27	25		Weſt	—ſtands, foggy and much Ice.
	9	36½	32½							Calm	—riſing, ſerene.

Months and Days.	Hours.	Barom. Alt.	Therm. Alt.	Lat. *p. Davis* or Act.	Lat. *per Elton.*	Obſ.	Long.	Variat.	Obſ.	Winds.	Weather.
1731	9	36	32	Acc.						S S E	☿ riſing, hazy.
July 25	12	35	31½	56.24	56.24	Obſ.	85.27	24		East	—continues riſing, fair.
	9	35	32½	Lat. *p.*		*p. El-*				S E b E	—ſtands, hazy, and cold Air.
	9	35	33½	Acct.		*ton.*				S S E	—ſomewhat fallen, hazy, & cold.
26	12	36	33½	55.39		55.33	85.40	24		N b E	—falling, Rain, and freſh Gales.
	9	36	34							N N W	—ſtands, thick and rainy.
27	9	37	35							E N E	—continues falling, fair and cold.
	12	37	34½	54.23			85.48	24		E b N	—ſtands, cold, and much Ice.
	9	37	35							N b E	—as above, freſh Gale, cold.
28	9	37	34¾							N b W	—as above, moderate and hazy.
	12	37	34½	53.57				24		N N W	—ſtands, moderate and fair.
	9	35	30							S W	—riſing, fair pleaſant Weather.
29	9	35	30½							S W b W	—at a ſtand, cloudy with Rain.
	12	34	31	53.29				25		S W	—riſing, Thunder and Rain.
	9	33	31								—riſing, freſh Gales with Rain.
30	9	37	32							N N W	—much fallen, moderate.
	12	36	29								—riſing, fair and Moderate.
	9	35	29½								—continues riſing, fair and ſettled.
31	9	31	27								—riſing, ſqually, with Rain.
	12	31	27								—as above, fair and moderate.
	9	29	25								—riſing quick, fair.
August 1	9	26	22								—continues riſing, warm & fair.
August 20	9	30	35							W N W	Hazy and moderate.
	12	33	27	52.40			52.42			N N W	☿ ſtands, hazy.
	9	35	30		*p. Da*				Obſ	Dit.	—ſtands, freſh Gales.
21	9	36½	30		*vis.*					North	—ſomewhat fallen, fair.
	12	37	31	52.54	52.55				Obſ.	North	—fallen.
	9	37	30½							Dit.	—falls, clear, ſerene, and cold.
22	9	36	28							S W b W	—riſes, fair light Breezes.
	12	36	29	52.57	52.59				Obſ.	Dit.	—ſtands, clear, and calm,
	9	35	29								—ſomewhat riſen, calm.
23	9	34½	29							S S E	—riſes, hazy.
	12	34	29	53.54						Dit.	—continues riſing, freſh Gales.
	9	33	30							S b W	—riſing, hazy, drops of Rain.
24	9	32	28½							S E	Fair and moderate.
	12	32	29	55.16				25		S E	Hazy.
	9	33	30							N E	Hazy and cloſe.
25	9	34	30½							N N E	☿ falls, foggy, and cold.
	12	35	31	55 48				26		Dit.	—continues fallen, cold.
	9	34	31							Dit.	—little riſing.
26	9	36	33							E S E	—fallen, moderate, and fair.
	12	36	33	56.55	56.56	56.56		28	Obſ.	Dit.	—ſtands, freſh Gales.
	9	37	34							E b N	Hard Gales.
27	9	40	34							E N E	—fallen, freſh Gales.
	12	40	34	58.14	58.13			29	Obſ.	Dit.	Hard Gales.
	9	40	34							E N E	—ſtands, moderate.
28	9	38	33							N N E	—ſomewhat riſen, fair.
	12	38	32	58.35	58.41			30	Obſ.	North	—ſtands, fair and moderate.
	9	38	32							North	Fair and calm.
29	9	37	31							Dit.	Fair and clear.
	12	37	30	59.24	59.33			31	Obſ.	N b W	☿ little riſen, fair.
	9	36	30							Weſt	—ſtands, fair Weather.
30	9	36	31							Calm	—ſtands, variable.
	12	37	30	59.55	60.5			31	Obſ.	E S E	—ſomewhat fallen.
	9	37	30							E b N	—ſtands, ſqually.
31	9	39	35							E N E	—fallen, freſh Gales.
	12	40	37	59.55				32		Dit.	—cont. fallen, fr. Gales & cloudy.
	9	40	37							Dit.	—ſtands, ſqually.
Sept. 1	9	40	36							N E	—ſtands, great Sea.
	12	40	36½	59.25				31		Dit.	
	9	41	36								
2	9	42	36½							E N E	—fallen, flying Clouds.
	12	43	36½	59.43	59.36			32	Obſ.	Dit.	—continues falling, moderate.
	9	42	34							N N W	Moderate.
3	9	41	35							S W	—riſing, freſh Gales.
	12	40	35½	60.40				33		Dit.	—continues riſing, hard Gales.
	9	35	35							Dit.	—riſing faſt, very hard Gales.
4	9	32½	32½							Dit.	—ſtill riſing, blowing very hard.
	12	31	33	61.33				35		Dit.	—continues riſing, foggy.
	9	30	33							W S W	Thick Fog.
5	9	34	33							N b E	☿ fallen, freſh Gales.
	12	37	35	62.12				38		Dit.	Freſh Gales.
	9	38	35½							Dit.	—continues fallen, moderate.
6	9	42	37							N E b N	—ſtands, hazy, Snow,
	12	42	36½	62.37		62.49		42	Obſ.	Dit.	—ſtands, thick Weather.
	9	42	36½							S E	—the ſame.
7	9	42	37								Cont. hazy, white Ledges of Ice.
	12	42	37	63.10		63.21		42	Obſ.	S E	Ditto.
	9	42	36½							Dit.	The ſame, Fogs and freezing.
8	9	41	36							E S E	☿ ſomewhat riſen, foggy.
	12	41	35½	63.25				41		Dit.	—ſtands.
	9	41	35½							Dit.	—the ſame, fair.
9	9	41	35							Calm	—the ſame.
	12	40	34½	63.19		63.13		40	Obſ	N W b W	—ſomewhat riſen, fair.
	9	41	35½							Dit.	—fallen, fair.
10	9	42	37							N b W	—continues fallen, fair.
	12	42	38	62.48	62.30			41	Obſ.	Dit.	—the ſame.
	9	43	38							Dit.	—fallen, fair.
11	9	44	38							Dit.	—fallen, fair.
	12	45	38½	61.43				40		Dit.	—continues fallen, fair and cold
	9	45	38							North	—at a ſtand, fair.
12	9	44	37½							W N W	—riſen, fair.
	12	42	36½	61.31	61.29			40	Obſ.	Weſt	—riſen, hazy weather, much Ice.
	9	41	36							Dit.	—riſing, fair and clear.
13	9	40½	36							N W	Fair.
	12	40	36	61.16	61.5		60.18	38	Obſ.	Dit.	Fair and moderate.
	9	40	36								—the ſame, cloudy.
14	9	40	35½							N W	—the ſame, fair.
	12	39	35	60.36			57.12	38		Dit.	Fair and cloudy.
	9	38	35							N W b N	—riſing, hazy, with Snow.
15	9	37	35½							N N E	—riſen, foggy.
	12	37½	36	59.41	59 28		52.29	35	Obſ.	Dit.	Fair.
	9	37½	35							N W	
16	9	37½	34½							Weſt	—ſtands, cloudy.
	12	37½	33½	58.20	58.10		47.18	33	Obſ.	N W b W	—the ſame, cloudy.
	9	37½	33½								—ſtands, variable.
17	9	37	33							N N W	—the ſame, cloudy.
	12	37½	33½	57.15			43.44	29		Dit.	—ſomewhat fallen, cloudy.
	9	37½	33							Dit.	Calm.
18	9	27	28½							S W	—riſing quick, freſh Gales.
	12	26	28½	56.35	56.25		42.32	27	Obſ.	Dit.	—little riſing, cloudy.
	9	26	28½							Weſt	—ſtands, ſqually, with Rain.
19	9	34	29							N W	Clear, with freſh Gales.
	12	35	30	55.23	55.29		38.48	25	Obſ	Dit.	—ſtill falling, fair.
	9	35	31							Dit.	—ſtands, fair, ſqually.
20	9	34½	30½							W N W	—riſing, ſqually with Hail.
	12	33½	31	54.23			34.19	22		Dit.	Hard Squalls.
	9	33½	31								—at a ſtand, hard Squalls.
21	9	33	30							N W	Squally with freſh Gales.
	12	33	29½	53.9			29.51	20		Dit.	—ſtands, clear freſh Gales.
	9	34	29							Dit.	—ſomewhat fallen.

Months and Days.	Hours.	Barom. Alt.	Therm. Alt.	Lat. Acct.	Lat. p. *Davis*	Lat. *per Elton.*	Long.	Need. Variat.	Obſ.	Winds.	Weather.
1731	9	34	28⅕							N b W	☿ ſtands, fair.
Sept. 22	12	35	28	52.7	52.14		26 25	19	Obſ.	N W b W	—fallen, clear.
	9	30	25							S W	—riſing quick, cloudy.
23	9	28	25							S b E	—ſtill riſing, hard Gales.
	12	24	24							Dit.	—riſing quick, thick and dirty.
	9	21	21								—continues riſing.
24	9	22	22							Eaſt	—ſtands, cloudy and Rain.
	12	22½	22½	52.30			23.12	17		Dit.	Ditto, freſh Gales.
	9	22½	22½							Dit.	—at a ſtand, cloudy.
25	9	21½	22							South	—riſing, ſqually and Rain.
	12	21½	22	51.50	51.54		20.24	16	Obſ.	Dit.	—the ſame, freſh Gales.
	9	21	22							W S W	—the ſame, ſqually with Rain.
26	9	21	21½							S W	Fair, freſh Breeze.
	12	21	21½	50.38	50.46		17.12	16	Obſ.	S b W	Fair and clear.
	9	21	21							Dit.	—the ſame, freſh Gales.
27	9	22	21							Weſt	—little fallen, fair and cloudy.
	12	23	20½	49.28	49.28		13.26	15	Obſ.	Dit.	Fair.
	9	22	20							S W	A great Sea, ſqually.

Months and Days.	Hours.	Barom. Alt.	Therm. Alt.	Lat. Acct.	Lat p. *Davis*	Lat. p. *Elton.*	Long	Variat.	Obſ	Winds.	Weather.
1731	9	20	19							S W	☿ riſing, freſh Gales and Rain.
Sept. 28	12	19	18	49 15	49.2		9.21	14	Obſ.	Dit.	—continues riſing, freſh Gales.
	9	21	18½							W S W	—little fallen, fair Weather.
29	9	23	18½							S b W	—fallen, hazy, freſh Gales.
	12	22	18	49.32			5.18	14		Dit.	
	9	22	18							S W b S	—at a ſtand, freſh Gales.
30	9	22	18							Dit.	—the ſame, hazy.
	12	22	18	49.18	49.30			14	Obſ.	S W	—at a ſtand, hazy
	9	22	18								—continues the ſame, ſqually.
Oct. 1	9	24	17							Weſt	—fallen, fair and clear.
	12	26	19	50. 2				14		W S W	—continues fallen, fair.
	9	28	21							Dit.	—fallen, fair and clear.
2	9	29	21							Dit.	
	12	29	21							Dit.	—continues, pleaſant.
	9	30	22							Dit.	—the ſame, fair and clear.

January 28, 1731-2.

THESE will inform you of my Sentiments concerning Mr *Patrick*'s Marine-Barometer, which I have made uſe of for two Voyages to *Hudſon*'s-*Bay* in *North America*, and by the ſtricteſt Obſervations, I have always found it to give me timely Notice of all bad Weather, and likewiſe of veerable Winds; as alſo, certain Intelligence of our coming nigh any Ice, with the Quantity we had to go through. It is an Inſtrument of excellent Uſe, I having continually found myſelf obliged to conform to it's more certain Information before all other ocular Appearances in the Horizon whatever. I muſt likewiſe inform you, that when we come in or near Ice we are obliged to keep one of our Compaſſes continually moving, there being either ſome magnetick Particles in the Air, or ſome other Quality that hinders them from traverſing, which makes our Courſe very difficult to direct; this happens generally in our entring *Hudſon*'s-*Streights* and *Bay*, but never ſo without being near or amongſt Ice. I have enquired of the Commanders, and others that uſe *Greenland* and *Davis*'s-*Streights*, and find great Complaints from them of their Compaſſes not traverſing. I have tried the Needle of the Azimuth Compaſs without the Chart, and find it to traverſe much better, ſo that I deſign next Voyage to have Iſing-Glaſs Charts, as being lighter.

paſt, on the Barometer and Thermometer, as ſoon as I ſhall have adapted them to the Effect which I juſt now ſaid that Heat and Cold produce upon the Mercury. I am informed, that four or five Years ago, the *Royal Society* ſent to M. *Abraham Vater* at *Wittenberg*, large Thermometers of Spirit of Wine, made and regulated by an Inſtrument-Maker of the *Royal Society*, in order to compare the Obſervations to be made in *Germany*, by the Means of thoſe Thermometers, with the Obſervations made in *England* by the like Thermometers, the one being regulated by the others. M. *Weidler*, Profeſſor of Mathematicks at *Wittenberg*, mentions in the Account which he gave of his Meteorological Obſervations for the Year 1729, that he has furniſhed himſelf with one, which he intends to make uſe of hereafter for his Meteorological Obſervations. He alſo ſays, that the Obſervers of the *Royal Society* of *Berlin*, make uſe of a like Thermometer; and I have myſelf received from thence, Obſervations on the Heights of the Thermometer of Spirit of Wine, made probably with that Inſtrument, for the whole Year 1729, and for the firſt three Months of 1731. Thoſe Obſervations are engraven on Copper-Plates, where the Heights of the Spirit of Wine are expreſſed in Parts of the *French*, *Engliſh*, and *Rhinland* Foot. If the *Royal Society* approve of this Sort of Thermometers, and are deſirous I ſhould compare them with mine; if they alſo deſire that Meteorological Obſervations with thoſe Thermometers of Spirit of Wine ſhould be made in *Ruſſia*, I beg you would ſend me ſeveral of them; but then I beg that thoſe you ſend me, be well regulated, and exactly compared with thoſe the Obſervers of the *Royal Society* make uſe of; ſuppoſing that ſome Perſon or other of their Body is appointed to keep Journals of theſe Obſervations. I ſhall ſend in exchange to the *Royal Society*, if they deſire it, ſome Thermometers of Mercury regulated by and compared with the four large ones which I made here.

XIV. My Mercurial Thermometer abroad, was laſt night, at 10 o'Clock, 20 Degrees above the freezing Point; which is higher than it was ſixteen Mornings of the one and-thirty in *May* laſt, and higher than in any Morning in *April* one excepted. *Tooting, Surry, 20. Jan.* 1741/2.

An Obſervation of extraordinary Warmth of the Air in Jan. 1741-2. *by the Rev. Mr* H. Miles, No. 462. p. 20. *Read* Jan. 21. 1741-2.

XV. *(See the folded Sheet.)*

XVI. I Obſerved that the *Hares*, *Rabbets*, *Foxes*, and *Partridges*, in *September*, and the Beginning of *October*, changed their native Colour to a ſnowy White; and that for ſix Months, in the ſevereſt Part of the Winter, I never ſaw any but what were all white, except ſome *Foxes* of a different Sort, which were grizzled, and ſome half red, half white.

That Lakes and ſtanding Waters, which are not above 10 or 12 Feet deep, are frozen to the Ground in Winter, and the Fiſhes therein all periſh.

Yet in Rivers near the Sea, and Lakes of a greater Depth than 10 or 12 Feet, Fiſhes are caught all the Winter, by cutting Holes through the

The Effects of Cold; together with Obſervations of the Longitude, Latitude, and Declination of the Magnetic Needle, at Prince of

Wales's Fort, *upon* Churchchill River *in* Hudſon's Bay, North America; *by Capt.* Chriſtopher Middleton, *F.R.S. Commander of His* MAJESTY's *Ship* Furnace, 1741-2. No. 465. p. 157. *Read* Oct. 28. 1742.

the Ice down to the Water, and therein putting Lines and Hooks. But if they are to be taken with Nets, they cut ſeveral Holes in a ſtrait Line the Length of the Net, and paſs the Net, with a Stick faſtened to the Head-Line, from Hole to Hole, till it reaches the utmoſt Extent; and what Fiſhes come to theſe Holes for Air, are thereby entangled in the Net; and theſe Fiſh, as ſoon as brought into the open Air, are inſtantaneouſly frozen as ſtiff as Stock-fiſh. The Seamen likewiſe freſhen their ſalt Proviſions, by cutting a large Hole through the Ice in the Stream or Tide of the River, which they do at the Beginning of the Winter, and keep it open all that Seaſon. In this Hole they put their ſalt Meat, and the Minute it is immerſed under Water, it becomes pliable and ſoft, though before it's Immerſion it was hard frozen.

Beef, *Pork*, *Mutton*, and *Veniſon*, that are killed at the Beginning of the Winter, are preſerved by the Froſt, for Six or Seven Months, intirely free from Putrefaction, and prove tolerable good eating. Likewiſe *Geeſe*, *Partridges*, and other Fowl, that are killed at the ſame time, and kept with their Feathers on, and Guts in, require no other Preſervative but the Froſt to make them good wholſome eating, as long as the Winter continues. All kinds of Fiſh are preſerved in the like manner.

In large Lakes and Rivers, the Ice is ſometimes broken by impriſoned Vapours; and the Rocks, Trees, Joiſts, and Rafters of our Buildings, are burſt with a Noiſe not leſs terrible than the firing off a great many Guns together. The Rocks which are ſplit by the Froſt, are heaved up in great Heaps, leaving large Cavities behind; which I take to be cauſed by impriſoned watery Vapours, that require more Room, when frozen, than they occupy in their fluid State. Neither do I think it unaccountable, that the Froſt ſhould be able to tear up Rocks and Trees, and ſplit the Beams of our Houſes, when I conſider the great Force and Elaſticity thereof. If Beer or Water is left in Mugs, Cans, Bottles, nay in Copper Pots, though they were put by our Bed-ſides, in a ſevere Night they are ſurely ſplit to pieces before Morning, not being able to withſtand the expanſive Force of the incloſed Ice.

The Air is filled with innumerable Particles of Ice, very ſharp and angular, and plainly preceptible to the naked Eye. I have ſeveral times this Winter tried to make Obſervations of ſome celeſtial Bodies, particularly the Emerſions of the Satellites of *Jupiter*, with Reflecting and Refracting Teleſcopes; but the Metals and Glaſſes, by that Time I could fix them to the Object, were covered a quarter of an Inch thick with Ice, and thereby the Object rendered indiſtinct, ſo that it is not without great Difficulties that any Obſervations can be taken.

Bottles of *ſtrong Beer*, *Brandy*, *ſtrong Brine*, *Spirits of Wine*, ſet out in the open Air for Three or Four Hours, freeze to ſolid Ice. I have tried to get the Sun's Refraction here to every Degree above the Horizon, with *Elton*'s Quadrant, but to no purpoſe, for the Spirits froze almoſt as ſoon as brought into open Air.

The

The Froſt is never out of the Ground, how deep we cannot be certain. We have dug down 10 or 12 Feet, and found the Earth hard frozen in the Two Summer Months; and what Moiſture we find five or ſix Feet down, is white like Ice.

The Waters or Rivers near the Sea, where the Current of the Tide flows ſtrong, do not freeze above 9 or 10 Feet deep.

All the Water we uſe for Cooking, Brewing, *&c.* is melted Snow and Ice; no Spring is yet found free from freezing, though dug never ſo deep down. All Waters in-land are frozen faſt by the Beginning of *October*, and continue ſo till the Middle of *May*.

The Walls of the Houſe we live in, are of Stone, 2 Feet thick, the Windows very ſmall, with thick wooden Shutters, which are cloſe ſhut 18 Hours every Day in the Winter. There are Cellars under the Houſe, wherein we put our *Wines*, *Brandy*, *ſtrong Beer*, *Butter*, *Cheeſe*, &c. Four large Fires are made in great Stoves, built on purpoſe, every Day: As ſoon as the Wood is burnt down to a Coal, the Tops of the Chimneys are cloſe ſtopped with an Iron Cover: This keeps the Heat within the Houſe (though at the ſame time the Smoke makes our Heads ake, and is very offenſive and unwholſome); notwithſtanding which, in 4 or 5 Hours after the Fire is out, the Inſide of the Walls of our Houſe and Bed-places will be 2 or 3 Inches thick with Ice, which is every Morning cut away with a Hatchet. Three or Four times a Day we make Iron Shot of 24 Pounds Weight red-hot, and hang them up in the Windows of our Apartments. I have a good Fire in my Room the major Part of the 24 Hours, yet all this will not preſerve my *Beer*, *Wine*, *Ink*, &c. from freezing.

For our Winter Dreſs we make uſe of 3 Pair of Socks of coarſe Blanketting or Duffield for the Feet, with a Pair of *Deer-Skin* Shoes over them; two Pair of thick *Engliſh* Stockings, and a Pair of Cloth Stockings upon them; Breeches lined with Flannel; two or three *Engliſh* Jackets, and a Fur or Leather Gown over them; a large Beaver Cap, double, to come over the Face and Shoulders, and a Cloth of Blanketting under the Chin; with Yarn Gloves, and a large Pair of Beaver Mittings hanging down from the Shoulders before, to put our Hands in, which reach up as high as our Elbows; yet notwithſtanding this warm Cloathing, almoſt every Day, ſome of the Men that ſtir abroad, if any Wind blows from the Northward, are dreadfully frozen; ſome have their Arms, Hands, and Face bliſtered and frozen in a terrible manner, the Skin coming off ſoon after they enter a warm Houſe, and ſome have loſt their Toes. Now their lying-in for the Cure of theſe frozen Parts, brings on the Scurvy in a lamentable manner. Many have died of it, and few are free from that Diſtemper. I have procured them all the Helps I could, from the Diet this Country affords in Winter, ſuch as freſh Fiſh, Partridges, Broths, *&c.* and the Doctors have uſed their utmoſt Skill in vain; for I find nothing will prevent that Diſtemper from being mortal, but Exerciſe and ſtirring abroad.

Coronæ

Coronæ and *Parhelia*, commonly called *Halo*'s, and *Mock-Suns*, appear frequently about the Sun and Moon here. They are ſeen once or twice a Week about the Sun, and once or twice a Month about the Moon, for 4 or 5 Months in the Winter, ſeveral *Coronæ* of different Diameters appearing at the ſame time.

I have ſeen 5 or 6 parallel *Coronæ* concentric with the Sun ſeveral times in Winter, being for the moſt part very bright, and always attended with *Parhelia* or *Mock-Suns*. The *Parhelia* are always accompanied with *Coronæ*, if the Weather is clear; and continue for ſeveral Days together, from the Sun's Riſing to his Setting. Theſe Rings are of various Colours, and about 40 or 50 Degrees in Diameter.

The frequent Appearance of theſe *Phænomena* in this frozen Clime ſeems to confirm *Deſcartes*'s Hypotheſis, who ſuppoſes them to proceed from Ice ſuſpended in the Air.

The *Aurora Borealis* is much oftener ſeen here than in *England*; ſeldom a Night paſſes in the Winter free from their Appearance. They ſhine with a ſurpriſing Brightneſs, darkening all the Stars and Planets, and covering the whole Hemiſphere: Their tremulous Motion from all Parts, the Beauty and Luſtre, are much the ſame as in the Northern Parts of *Scotland* and *Denmark*, &c.

The dreadful long Winters here may almoſt be compared to the Polar Parts, where the Abſence of the Sun continues for ſix Months; the Air being perpetually chilled and frozen by the Northerly Winds in Winter, and the cold Fogs and Miſts obſtructing the Sun's Beams in the ſhort Summer we have here; for notwithſtanding the Snow and Ice is then diſſolved in the Low-lands and Plains, yet the Mountains are perpetually covered with Snow, and incredible large Bodies of Ice continue in the adjacent Seas. If the Air blows from the Southern Parts, the Air is tolerably warm, but very cold when it comes from the Northward, and it ſeldom blows otherwiſe than between the North-eaſt and North-weſt, except in the two Summer Months, when we have, for the major Part, light Gales between the Eaſt and the North, and Calms.

The Northerly Winds being ſo extremely cold, is owing to the Neighbourhood of high Mountains, whoſe Tops are perpetually covered with Snow, which exceedingly chills the Air paſſing over them. The Fogs and Miſts that are brought here from the Polar Parts, in Winter, appear viſible to the naked Eye in Icicles innumerable, as ſmall as fine Hairs or threads, and pointed as ſharp as Needles. Theſe Icicles lodge in our Cloaths, and, and if our Faces or Hands be uncovered, they preſently raiſe Bliſters as white as a Linnen Cloth, and as hard as Horn. Yet if we immediately turn our Backs to the Weather, and can bear our Hand out of our Mitten, and with it rub the bliſtered Part for a ſmall time, we ſometimes bring the Skin to it's former State: If not, we make the beſt of our Way to a Fire, and get warm Water, wherewith we bathe it, and thereby diſſipate the Humours raiſed by the frozen Air; otherwiſe the Skin would be off in a ſhort time, with much hot, ſerous,

watry

watry Matter coming from under along with the Skin; and this happens to ſome almoſt every time they go abroad for five or ſix Months in the Winter, ſo extreme cold is the Air when the Wind blows any thing ſtrong.

Now I have obſerved, that when it has been extreme hard Froſt by the Thermometer, and little or no Wind that Day, the Cold has not near ſo ſenſibly affected us, as when the Thermometer has ſhewed much leſs freezing, having a briſk Gale of Northerly Wind at the ſame time. This difference may perhaps be occaſioned by thoſe ſharp-pointed Icicles before-mentioned ſtriking more forcibly in a windy Day, than in calm Weather, thereby penetrating the naked Skin, or Parts but thinly covered, and cauſing an acute Senſation of Pain or Cold: And the ſame Reaſon, I think, will hold good in other Places; for ſhould the Wind blow Northerly any thing hard for many Days together in *England*, the Icicles that would be brought from the Polar Parts by the Continuance of ſuch a Wind, though imperceptible to the naked Eye, would more ſenſibly affect the naked Skin, or Parts but ſlightly covered, than when the Thermometer has ſhewn a greater Degree of freezing, and there has been little or no Wind at the ſame time.

It is not a little ſurprizing to many, that ſuch extreme Cold ſhould be felt in theſe Parts of *America*, more than in Places of the ſame Latitude on the Coaſt of *Norway*; but the Difference I take to be occaſioned by Wind blowing conſtantly here, for 7 Months in the 12, between the N E and N W, and paſſing over a large Tract of Land, and exceeding high Mountains, *&c.* as before-mentioned. Whereas at *Drunton* in *Norway*, as I obſerved ſome Years ago in wintering there, the Wind all the Winter comes from the N and N N W, and croſſes a great Part of the Ocean clear of thoſe large Bodies of Ice we find here perpetually. At this Place we have conſtantly every Year 9 Months Froſt and Snow, and unſufferable Cold from *October* till the Beginning of *May*. In the long Winter, as the Air becomes leſs ponderous towards the Polar Parts, and nearer to an *Æquilibrium*, as it happens about one Day in a Week, we then have Calms and light Airs all round the Compaſs, continuing ſometimes 24 Hours, and then back to it's old Place again, in the ſame manner as it happens every Night in the *Weſt-Indies*, near ſome of the Iſlands.

The Snow that falls here is as fine as Duſt, but never any Hail, except at the Beginning and End of Winter. Almoſt every Full and Change of the Moon, very hard Gales from the North.

The conſtant Trade Winds in theſe Northern Parts I think undoubtedly to proceed from the ſame Principle, which Dr *Halley* conceives to be the Cauſe of the Trade Winds near the Equator, and their Variations.

" Wind, ſays he, is moſt properly defined to be the Stream or Cur-
" rent of the Air; and where ſuch a Current is perpetual and fixed in
" it's Courſe, it is neceſſary, that it proceed from a permanent and un-

" intermitting Cauſe, capable of producing a like conſtant Effect, and " agreeable to the known Properties of Air and Water, and the Laws " of Motion of fluid Bodies. Such an one is, I conceive, the Action " of the Sun's Beams upon the Air and Water, as he paſſes every Day " over the Oceans, conſidered together with the Nature of the Soil and " Situation of the adjoining Continents. I ſay, therefore, firſt, That " according to the Laws of *Statics*, the Air which is leſs rarefied or ex- " panded by Heat, and conſequently more ponderous, muſt have a " Motion towards thoſe Parts thereof which are more rarefied, and leſs " ponderous, to bring it to an *Æquilibrium*, &c."

Now, that the cold denſe Air, by reaſon of it's great Gravity, continually preſſes from the Polar Parts towards the Equator, where the Air is more rarefied, to preſerve an *Æquilibrium* or Balance of the Atmoſphere, I think, is very evident from the Wind in thoſe frozen Regions blowing from the N and N W, from the Beginning of *October* until *May*; for we find, that when the Sun, at the Beginning of *June*, has warmed thoſe Countries to the Northward, then the South-eaſt, Eaſt, and variable Winds continue till *October* again; and I do not doubt but the Trade Winds and hard Gales may be found in the Southern Polar Parts to blow towards the Equator, when the Sun is in the Northern Signs, from the ſame Principle.

The Limit of theſe Winds from the Polar Parts, towards the Equator, is ſeldom known to reach beyond the 30th Degree of Latitude; and the nearer they approach to that Limit, the ſhorter is the Continuance of thoſe Winds. In *New-England* it blows from the North near 4 Months in the Winter; at *Canada*, about 5 Months; at the *Danes* Settlement in *Streights Davis*, in the 63d Degree of Latitude, near 7 Months; on the Coaſt of *Norway*, in 64, not above 5 ½ Months, by Reaſon of blowing over a great Part of the Ocean, as was before-mentioned; for thoſe Northerly Winds continue a longer or ſhorter Space of Time, according to the Air's being more or leſs rarefied, which may very probably be altered ſeveral Degreees, by the Nature of the Soil, and the Situation of the adjoining Continents.

The vaſt Bodies of Ice we meet with in our Paſſage from *England* to *Hudſon's-Bay*, are very ſurpriſing, not only as to Quantity, but Magnitude, and as unaccountable how they are formed of ſo great a Bulk, ſome of them being immerſed 100 Fathom or more under the Surface of the Ocean; and ⅓ or ⅙ Part above, and 3 or 4 Miles in Circumference. Some Hundreds of theſe we ſometimes ſee in our Voyage here, all in Sight at once, if the Weather is clear. Some of them are frequently ſeen on the Coaſts and Banks of *Newfoundland* and *New-England*, though much diminiſhed.

When I have been becalmed in *Hudſon's-Streights* for 3 or 4 Tides together, I have taken my Boat, and laid cloſe to the Side of one of them, ſounded, and found 100 Fathom Water all round it. The Tide floweth here above 4 Fathom; and I have obſerved, by Marks upon a Body of

Ice,

Ice, the Tide to riſe and fall that Difference, which was a Certainty of it's being aground. Likewiſe, in a Harbout in the Iſland of *Reſolution*, where I continued 4 Days, 3 of theſe Iſles of Ice (as we call them) came aground. I ſounded along by the Side of one of them, quite round it, and found 32 Fathom Water, and the Height above the Surface but 10 Yards; another was 28 Fathom under, and the perpendicular Height but 9 Yards above the Water.

I can in no other manner account for the Aggregation of ſuch large Bodies of Ice but this: All along the Coaſts of *Streights Davis*, both Sides of *Baffin*'s-*Bay*, *Hudſon*'s-*Streights*. *Anticoſh*, or *Labradore*, the Land is very high and bold, and 100 Fathoms, or more, cloſe to the Shore. Theſe Shores have many Inlets or Fuirs, the Cavities of which are filled up with Ice and Snow, by the almoſt perpetual Winters there, and frozen to the Ground, increaſing for 4, 5, or 7 Years, till a kind of Deluge or Land-flood, which commonly happens in that Space of Time throughout thoſe Parts, breaks them looſe, and launches them into the Streights or Ocean, where they are driven about by the variable Winds and Currents in *June*, *July*, and *Auguſt*, rather increaſing than diminiſhing in Bulk, being ſurrounded (except in 4 or 5 Points of the Compaſs) with ſmaller Ice for many Hundred Leagues, and Land covered all the Year with Snow, the Weather being extreme cold, for the moſt part, in thoſe Summer Months. The ſmaller Ice that almoſt fills the Streights and Bays, and covers many Leagues out into the Ocean along the Coaſt, is from 4 to 10 Fathom thick, and chills the Air to that Degree, that there is a conſtant Increaſe to the large Iſles by the Sea's waſhing againſt them, and the perpetual wet Fogs, like ſmall Rain, freezing as they ſettle upon the Ice; and their being ſo deeply immerſed under Water, and ſuch a ſmall Part above, prevents the Wind's having much Power to move them: For though it blows from the N W Quarter near 9 Months in 12, and conſequently thoſe Iſles are driven towards a warmer Climate, yet the progreſſive Motion is ſo ſlow, that it muſt take up many Years before they can get 500 or 600 Leagues to the Southward; I am of Opinion ſome Hundreds of Years are required; for they cannot, I think, diſſolve before they come between the 50th and 40th Degree of Latitude, where the Heat of the Sun conſuming the upper Parts, they lighten and waſte in Time: Yet there is a perpetual Supply from the Northern Parts, which will ſo continue as long as it pleaſes the AUTHOR of all Beings to keep things in their preſent State.

Obſervations of the Longitude, Latitude, and the Declination of the Magnetic Needle, at Prince of Wales's Fort, Churchill-River.

	h	′	″
Having obſerved the apparent Time of an Emerſion of *Jupiter*'s firſt *Satellite* at *Fort-Churchill*, on *Saturday* the 20th of *March* laſt 1741-2, at — — — —	11	55	50
I find the ſame Emerſion happened at *London*, by Mr *Pound*'s Tables, compared with ſome Emerſions actually obſerved in *England* near the ſame, at — — —	18	15	10

	h	′	″
Whence the horary Difference of Meridians, between *Fort-Churchill* and *London*, comes out — — —	6	19	20
Which converted into Degrees of the Equator, gives for the Distance of the same Meridians — — — —	° 94	′ 50	″ 00

Wherefore, since the Time at *London* was later in Denomination than that at *Churchill*, it follows that, according to this Observation, *Churchill* is 94 Degrees 50 Minutes, in Longitude West of *London*.

I took several other Observations, which agreed one with another to less than a Minute, but this I look upon as the most distinct and best.

The Observation was made with a good 15 Foot Refracting Telescope, and a Two Foot Reflector of *Gregory*'s Kind, having a good Watch of Mr *Graham*'s that I could depend upon; for I have frequent Opportunities of discovering how much it's Variation amounted to, and constantly found it's daily Deviation or Error to be 15 Seconds too slow; by which means it was as useful to me for all Purposes, as if it had gone most constantly true without any Change. This Watch I kept in my Fob in the Day and in Bed in the Night, to preserve it from the Severity of the Weather; for I observed, that all other Watches were spoiled by the extreme Cold.

I have found, from repeated Observations, a Method of obtaining the true Time of the Day at Sea, by taking 8 or 10 different Altitudes of the Sun or Stars, when near the Prime Vertical, by Mr *Smith*'s or Mr *Hadley*'s Quadrant, which I have practised these 3 or 4 Years past, and never found from the Calculations, that they differed one from another more than 10 or 15 Seconds of Time. This Certainty of the true Time at Sea is of greater Use in the Practice of Navigation, than may appear at first Sight; for you thereby not only get the Variation of the Compass without the Help of Altitudes, but likewise the Variation of the Needle from the true Meridian, every time the Sun or Star is seen to transit the same. Also having the true Time of Day or Night, you may be sure of the Meridian Altitude of the Sun or Star, if you get a Sight 15 or 20 Minutes before or after it passes the Meridian; and the Latitude may be obtained to less than Five Minutes, with several other Uses in Astronomical Observations; as the Refraction of the Atmosphere, and to allow for it, by getting the Sun's apparent Rising and Setting, which any body is capable of doing, and from thence you will have the Refraction.

If we had such a Telescope contrived as Mr *Smith* recommends to be used on Shipboard at Sea, now we can have an exact Knowledge of the true Time of the Day or Night from the above Instruments and a good Watch, I hope we should be able to observe the Eclipses of the first *Satellite* of *Jupiter*, or any other *Phænomenon* of the like Kind, and thereby find the Distance of Meridians, or Longitude at Sea.

The Variation of the Magnetical Needle, or Sea-Compass, observed by me at *Churchill* in 1725. (as in N.° 393, of the *Philosophical Transactions* for

for the Months of *March* and *April* 1726.) was at that Time North 21 Degrees Weſterly, and this Winter I have carefully obſerved it at the ſame Place, and find it no more than 17 Degrees, ſo that it has differed about One Degree in Four Years; for in 1738, I obſerved it here, and found it's Declination 18 Degrees Weſterly. I have carefully obſerved, and made proper Allowance for the Sun's Declination and Refraction, and find the Latitude here to be 58 Degrees 56 Minutes N: But in moſt Parts of the World, where the Latitudes are fixed by Seamen, they are for the moſt part falſely laid down, for want of having Regard to the Variation of the Sun's Declination, which, computed at a diſtant Meridian, when the Sun is near the Equator, may make a great Error in the Sun's riſing and ſetting *Azimuths*, &c.

Theſe things I thought proper to take Notice of, as they may be of Service to Navigators, and the Curious in Natural Inquiries.

XVII. This Treatiſe of Epidemicks is uſhered in by a large and learned Diſcourſe by way of *Prolegomena*; wherein the Author conſiders the various Properties of the Air, with it's Effects on living Bodies both in Health and Sickneſs; and then deſcribes the Method and Inſtruments he made uſe of in his Obſervations.

An Atcount of a Book intituled, Obſervationes de Aëre & Morbis epidemicis, ab Anno 1728, ad finem Anni 1737, Plymuthi factæ. Auctore Joanne Huxham, *M. D. R. S. S.* Londini, apud S. Auſten, 1739, 8*vo*. *Drawn up by* Thomas Stack, *M. D. F. R. S.* No. 451. p. 429. Dec. 1738.

His Method of obſerving the Weather, is that publiſhed by Dr *Jurin**.

His Inſtruments, a Barometer with a pretty large Tube, and a very wide Bowl, filled with Quickſilver well purged by Diſtillation. And this Barometer, to *June* 1733, ſtood about 46 Feet above the Level of the Sea at Low Water; but after that Time at 30 Feet only above the ſaid Level.

A Thermometer made by Mr *Hauksbee*.

The chief of his Hygroſcopes was made after that of Mr *Molyneux* †,

A round Funnel for collecting the Rain, 25 Inches in Diameter, and placed ſo as to be equally expoſed to all Winds.

And he cloſes the *Prolegomena* with an Account of the Situation of *Plymouth*; and with earneſtly expreſſing his Deſire of a general accurate Hiſtory of the Atmoſphere, towards which he contributes this his Mite.

In the Body of this uſeful Treatiſe, the ingenious Author gives for every ſeparate Month curious Abſtracts of his Meteorological Diary, *viz.* The Quantities of Rain for the reſpective Days; the Days on which there fell Hail, Snow, *&c.* The *Auroræ Boreales*, and other like Meteors: The Winds, with their Degrees of Force: The conſiderable Tides: The higheſt and loweſt Stations of the Barometer and Thermometer: The warmeſt and coldeſt Days, with the middle Temper of the Air. To theſe he ſubjoins the reigning or moſt epidemic Diſeaſes, and their Methods of Cure; with excellent medicinal Obſervations both Theore-

* See Vol. VI. Part. II. Chap. I. §. xxxvii.

† See Vol. II. Chap. I. §. xvi. 3.

tical

tical and Practical, thereon, as often as any thing new or uncommon occurred.

As a Specimen of the Work I beg Leave to exhibit some few of his Observations, both Philosophical and Medical, for each respective Year.

1723. *July* 2, at 11 at Night, no Wind stirring, our Author observed a very considerable *Aurora Borealis*, whose Beams shot upward, and terminated in a bright Canopy about 8 or 10 Degrees to the South of the Zenith; with it's Centre about the same Distance to the East of the Meridian. It was attended with a very plentiful Dew.

July 22. at 9. *p. m.* The Wind at North, with one Degree of Force; there was a small but uncommon *Aurora Borealis*, whose pyramidal Rays darted in an inverted Order; for their Points tended to the Centre, and ran below the Horizon at North.

	Inches.	Deci.
The whole Quantity of Rain collected this Year, was -	36.	364.
Of which fell in *January*, the wettest Month, — —	6.	108.
in *September*, the dryest, — — — —	1.	526.

	Inches.	
The highest Station of the Barometer was — — — — —	30. 3.	on *Feb.* 2. and *Dec.* 15.
lowest — — — — —	28. 5.	on *Jan.* 18. and *Sept.* 24.

In his general Observations on this Year, among other things, he observes, that the highest Tides generally happened when the Barometer was lowest: And he thinks, their Cause, in part at least, may be attributed to the Air being lighter on our Seas than on the main Ocean. He also suspects, that *Spouts* and *Boars* may derive their Origin from the same Cause, but acting with extraordinary Violence: As a Clap of Thunder, which causes a sort of *Vacuum* for an Instant.

This having been a wet Year, our Author takes occasion to account how a wet and cold Temper of the Air creates Heaviness, Colds, and other Diseases, from superabundant Serosity: How Fevers are produced by a moist and unelastic Air; and gives the manner of treating intermitting Fevers, with the Method and Use of Vomits; the different sorts of Asthma's with the Cure; and Cautions for avoiding the Contagion of the Air.

1729. *Jan.* 14. at 9. *p. m.* He observed a bight Cloud between *Orion*, the *Bull*, and the *Whale*'s Mouth, shooting forth very bright Rays: Though there was no Sign of an *Aurora Borealis* in any other Part of the Heavens all that Night.

	Inches.	Deci.
The Total of Rain this Year — — — — —	33.	055.
Of which *Sept.* the wettest Month, afforded — — —	6.	498.
January, the dryest. — — — — —	0.	900.

On

On Occaſion of his Thermometrical Obſervations made in *Feb.* he ſays, he has frequently obſerved Froſt in Spring, when Mr *Hauksbee*'s Thermometer was but at 55; whereas in Winter he has ſeen it at 65, and lower, without the leaſt appearance of Froſt: Wherefore he thinks, the Degree of Cold which produces Froſt, is not yet brought to a due Certainty; and that Congelation does not depend barely on a Privation of Motion or of Heat.

A ſlow putrid Fever was very epidemical part of this Summer and Autumn; which he aſcribes to the moiſt and hot Temper of the Air, and gives it's Deſcription and Cure.

1730. In the Beginning of *October* there was a violent Eaſterly Wind, which ſo diſturbed the Sea, that at 3 or 4 Miles from the Shore he found the Leaves of the Trees very ſalt to the Taſte.

	Inches.	Deci.
The Total of Rain this Year was — — — —	25.	698.
Whereof in *November* fell — — — — — —	4.	480.
in *January* but — — — — — —	0.	666.
Barometer higheſt on *Jan.* 10. — — — — —	30.	6.
loweſt *March* 7. — — — — —	28.	5.

On account of a particular Colic which reigned part of this Year, the Author remarks the pernicious Conſequences of giving general Names to Diſtempers; which often leads the Unſkilful into irreparable Errors in Practice.

	Inches.	Deci.
1731. This was a dry Year, the Total of Rain being but — — — — — — — — — — — —	17.	266.
Whereof in *Nov.* the wetteſt Month, fell — — —	2.	356.
in *March*, the dryeſt, — — — — —	0.	140.
Mercury higheſt on *March* 2. — — — — —	30.	4.
loweſt *November* 8. — — — — —	28.	7.

A very remarkable Fall of the Barometer happened between *Feb.* the 2d and the 9th, when the Mercury deſcended from 30. 3. to 28. 9.

Our Author has very often obſerved a very ſudden fall of the Mercury, without any conſiderable Change in the Face of the Atmoſphere; but upon a more ſtrict Inquiry, he found there had been either great Rain or Thunder ſomewhere in the Neighbourhood; to which Place the ambient Air ruſhed ſuddenly, in order to reſtore the *Æquilibrium*.

As inflammatory Diſeaſes of the Breaſt were fatal this Year, the Author takes Occaſion, in treating of them, to give the diſtinctive Characteriſtics of the true Pleuriſy and Peripneumony, and conſequently of the frequent Combination of both, or *Pleuro-Peripneumony*; with their different Methods of Cure.

	Inches.	Deci.
1732. The Total of Rain was — — — — —	33.	096.
Whereof in *October* fell — — — — — —	6.	342.
in *Auguſt* but — — — — — — —	0.	362.
Mercury higheſt *November* 25. — — — — —	30.	4.
loweſt *October* 14. — — — — — —	28.	7.

This Year contains excellent practical Obſervations on the Whooping Cough of Children.

	Inches.	Deci.
1733. Total of Rain — — — — — — —	29.	884.
Of which in *December* alone — — — — — —	4.	688.
in *July* but — — — — — — —	0.	772.

In *Dec.* though a very wet Month, the Barometer was high; which he attributes chiefly to the great Quantity of Vapours with which the Air was loaded.

	Inches.	Deci.
The higheſt Station of the Mercury was *Jan.* 24. *Mar.* 3. *Oct.* 18. *Nov.* 5. — — — — — — — —	30.	2.
June 18. and *Oct.* 25. loweſt — — — — — —	20.	8.

And 'tis very remarkable, that whereas the Mercury was at it's higheſt Station of 30. 2. on *Oct.* 18; it was fallen to it's loweſt of 28. 8. on *Oct.* 25. and riſen again to the higheſt on *Nov.* 5.

Here the Reader will find an accurate Deſcription of the Epidemical Colds of this Year, with their Cure.

	Inches.	Deci.
1734. Was a very wet Year, the Total of Rain being	37.	114.
Of which fell in *December* — — — — — —	6.	192.
in *January* but — — — — — —	1.	484.

The Mercury's higheſt Station 30. 4. on *Jan.* 29. *Feb.* 1. and *Nov.* 27.
loweſt — 28. 2. *Dec.* 14.

The moſt ſudden Change was between the 23d and 27th of *November*, when the Mercury roſe from 28. 8. to 30. 4.

Quinzeys were very rife this Year among young Folks; for which Reaſon they are here carefully deſcribed, with their various Changes and Cure.

	Inches.	Deci.
1735. Total of Rain fallen this Year — — — —	30.	974.
Whereof in *November* — — — — — —	4.	922.
in *May* — — — — — — —	1.	646.
Higheſt Station of the Mercury on *Jan.* 4. and *Feb.* 2. — — — — — — — — —	30.	5.
Loweſt — — — — — — *Jan.* 11. —	28.	1.

Where

Where it is obſervable, that between the 4th and 11th of *Jan.* the Mercury fell from it's higheſt Station of this Year, *viz.* 30. 5. to it's loweſt (and indeed a very low one) 28. 1.

Nov. 27. though the Moon was in one of the Quarters, the Tides were higher than they generally are at the New and Full.

This was a very moiſt Year as to the Frequency, though not the Quantity of Rain.

This Year a malignant Fever, with Spots, was brought to *Plymouth* by the Fleet, and became very epidemical and deſtructive; wherefore our Author takes great Pains to inveſtigate it's Nature, and gives the Method of Cure which beſt ſucceeded with him.

1736. *Feb.* 6. There was a conſiderable *Aurora Borealis*, wherein the Streamings darted from the very South; and the lucid Canopy was more to the Eaſt than the Author had ever obſerved before.

May 9. A large Halo round the Moon at 10 at Night, and at the ſame Hour on the 11th, another very large one, remarkable for it's fiery Colour.

Aug. 25. Wind W. 1 Deg. Between the Hours of 9 and 11, there appeared in the Heavens a narrow, but very bright Band, which extended entirely from Weſt to Eaſt, and was like a great Rainbow.

	Inches.	Deci.
The Total of Rain — — — — — — — —	36.	706.
Of which in *October* — — — — — — — —	6.	534.
in *November* — — — — — — — —	1.	150.
And on *July* 10, the Rain was ſo exceſſive, that from 3 *p. m.* to 5 the next Morning it amounted to — —	1.	686.
The Mercury's higheſt Station was on *Dec.* 24. — —	30.	4.
loweſt — — — *Oct.* 9. — —	28.	4.

1737. In *Auguſt* there were *Auroræ Boreales* for 4 ſucceſſive Nights, *viz.* from the 9th to the 12th. The firſt and laſt ſeem to have no particular Circumſtances attending them. That on the 10th, ſeen at 9 o'Clock, was very great. It's Rays were of various Colours, though all very bright and vivid; and formed a beautiful Canopy from the Zenith to about 12° Eaſtward, and a little to the South.

That on the 11th, about 10, was alſo conſiderable. The Canopy appeared in the ſame Place with that of the foregoing Night, and of the Colour of red-hot Iron.

Dec. 5. Our Author obſerved the remarkable red Lights*, and ſays, that in the Evening the Sky ſeemed overcaſt with a thin Cloud or Vapour, but looked as red as from the Reflexion of a great Fire; and it caſt as much Light as the Full Moon on a cloudy Night. This ſurpriſing *Phænomenon* laſted till near Midnight, but it's greateſt Brightneſs was

* See §. XLVI. of this Chapter.

between the Hours of 5 and 7. It cauſed great terrors among the Vulgar ſome apprehending a vaſt Fire, others thinking the Sky overſpread with Blood. For the greateſt Part of the Day the Air was cloudy and warm, with a gentle Rain falling often, eſpecially in the Afternoon, and ſcarce any Wind. In the Evening the Vapour emitted a diſagreeable Smell; and the Doctor happening to ride in the Rain, he perceived the Drops were of a maukiſh ſweet Taſte. This ſame *Phænomenon* was of great Extent in the Northern Parts of *Europe*; and at *Kilkenny* in *Ireland*, was ſeen ſomewhat like a Globe of Fire ſuſpended in the Air for near the Space of an Hour; which then burſting, ſpread Flames around on every Side.

	Inches.	Deci.
The total Quantity of Rain this Year was — — —	27.	364*.
Whereof fell in *March* alone — — — — —	4.	328.
in *May* but — — — — — —	0.	332.
The Mercury's higheſt Station in the Barometer was on *Jan.* 19. — — — — — — — — — —	30.	6.
loweſt *Sept.* 22. — — — — —	28.	5.

Towards the latter End of this Year, a catarrhal Fever broke out, and became very epidemic. It was indeed ſomewhat like the epidemic Colds of 1733, but much more ſevere. Here the Reader will find the Differences in their Symptoms and Cure well deſcribed: As alſo two valuable Diſſertations, one on the various Species of Jaundice, the other on nervous Fevers, ſo common of late Years: Which I think very worthy of a careful Peruſal by all Orders of Men, who have any Pretence to the Practice of Phyſic.

An Inquiry into the Cauſes of a dry and wet Summer. By— No. 458. p. 519. Sept. &c. 1740.

XVIII. The wet Weather which we had in *March* 1734, (the Year beginning with *Jan.*) ſet me on conſidering what might be the Cauſes of it. The Wind was then, generally, S W, the Weather rainy. Sometimes it veered to S E, which, commonly, brought much Rain: But the Wind ſeldom ſtood at that Point 24 Hours, before it returned to S W again. A ſtrong Gale at S W, with Rain, would be ſucceeded by as ſtrong at N W, ſtill raining; but if the N W continued 24 Hours, it cleared the Sky. The Summer following was cold and wet; the Wind on the ſame Points. The preceding Winter was mild, and eſpecially *Dec.* in which Month, from the 10th incluſive, the Wind blew, generally, S W, ſometimes ſtrong, attended with much Rain. At the End of *Dec.* the Birds ſang, and the Graſs did grow as at other Years in the Spring.

The Winter of 1734 was as mild as that of 1733, the Birds as joyful, and the Graſs as green at the End of *December*, the ſame Winds ſtill

* *N. B.* The Reader is deſired to take Notice of an Error in the Total of Rain for this Year, as it ſtands in the Book; where the Total of the preceding Year has by ſome Miſtake or other been repeated in this: And he is therefore intreated to correct it by the Total ſet down in this Abſtract.

prevailing;

prevailing; but the S W was more ſtormy. *Dec.* 29, there blew a Storm, firſt from S W, and then from N W: But the Storm of *Jan.* 8. was much ſtronger, which blew on the ſame Points. The Summer of 1735 was colder, and wetter than the preceding Summer.

This put me on recollecting what ſort of Winter went before a dry Summer. In the Year 1731, the Summer was remarkably dry. I had not begun to keep a Journal of the Weather in 1730. But I took ſo much Notice of the unuſual Cold in *April* 1731, that I made the following Remarks. *April* 1. begins with peircing cold Winds at N E, black Clouds, ſtormy, very dry. 4th, 5th, ſome Wind, Ice. 6th, 7th, 8th, 9th, ſame Wind. 9th, Snow. 10th, The Harbour frozen over. If my Memory doth not fail me very much, it was in the Winter of the Year 1730, or the Beginning of 1731, that a *Horſe* was frozen to Death in *Moſcow*, as he ſtood in the Street.

From hence I conclude, that a froſty Winter produces a dry Summer; and a mild Winter a wet Summer. I am ſenſible, that theſe Concluſions are drawn from ſhort and imperfect Obſervations: But, ſuppoſing them to be true, I would be glad to know why theſe things are ſo.

I find from theſe and ſome other Obſervations, which I have caſually made, that the Weather depends very much on the Wind. I ſhall therefore begin with inquiring what is the Cauſe of Winds, and then proceed to find out, as well as I can, why the Wind doth influence the Weather.

Wind is a Stream of Air; Air an unmixed Fluid encompaſſing our Globe, with a Shell of at leaſt 60 Miles thick. Every Particle of Air gravitates equally towards the Centre of the Earth. Air is capable of being compreſſed and expanded: The more Air is compreſſed, the heavier it is; the more it is expanded, the lighter. Cold and Heat, whatever they be, or however they act, produce theſe contrary Effects in the Air: That is, Cold doth compreſs the Air, and Heat expands it: Therefore Cold and Heat, in different Parts of the Air, will make it flow: For Cold making the Air heavy, and Heat making it light, the lighter muſt, of courſe, give Way to the heavier; as, in a Balance, a greater Weight makes a ſmaller riſe. We daily ſee a Proof of this in a Stove.

The Sea and Land-breezes, and the Trade-Wind, owe their Original to theſe Cauſes. The Sea-breeze, when regular, begins at 9 in the Morning, approaches the Shoar gently, at firſt; increaſes till 12; retains it's full Strength till 3; then gradually decreaſes till 5, when it dies away. At 6 in the Evening the Land-breeze begins, and continues till 8 next Morning: The Interval between theſe two Breezes, at Morning and Evening, are the hotteſt Parts of the Day. It is ſaid, that theſe Winds vary in their Periods; which not being to my Purpoſe, I take no Notice of.

The way of accounting for this Viciſſitude of Sea and Land-wind, is thus: The Sun, as it aſcends, ſheds it's Heat equally on the Land and

Sea; but the Earth receives the Heat ſooner than the Water, or elſe reflects it ſtronger. For one or both of theſe Reaſons, the Air that hangs over the Land, is heated more than the Sea-air, it becomes thereby more rarefied and conſequently lighter; and therefore the Sea-air, with it's ſuperior Weight, flows in upon it every Way. The Intervals between are owing to the Air of both Places being in an equal Degree of Heat, and conſequently of equal Weight.

The Trade-wind never varies, which is thus accounted for: The Air juſt under the Sun is the hotteſt: The cold Air preſſeth upon the hot, as the hot Air follows the Sun; and therefore it makes a perpetual Flow of Wind between the Tropics from *Africa* to *America*, and from thence to the *Eaſt-Indies*.

With regard to the Wind influencing the Weather; I find that though Air be an unmixed Fluid, yet it is capable of receiving many Vapours, which float in it, as we ſee other Bodies float in Water. Sometimes the Vapour aſcends, and ſometimes it falls to the Ground. All which I take to be effected by Heat and Cold in this Manner: Heat ſeparates Water into ſmall Particles, and the incorporated Air, rarefied by the ſame Heat, blows up thoſe Particles into Bubbles; by which means the ſwoln Vapour becoming ſpecifically lighter than a like Space of ambient Air, aſcends, ſwift, at firſt, (which affords a pleaſant Sight in a warm Summer's Day) and then gradually ſlower, till it gets up to that Part of the Air which is of equal Lightneſs with itſelf; and there it remains, as long as the Air continues in the ſame State: But whenever the Air cools, in which theſe watery Bladders float, the Cold contracts the Bladder, which becoming thereby ſpecifically heavier than the Air, down it falls in Dew, or Rain. A common Alembic ſufficiently ſhews the Operation of Heat and Cold on the aſcending and deſcending Vapour.

Thus in a calm Evening, when there is no Wind to waft the Air, as the Heat of the Sun declines, the Cold arreſts ſome few of the laſt aſcending Vapours, and, by it's own Force, without any other Change in the State of the Air, compels them to return, in Dew, to the very Spot from whence they aroſe; whilſt their Brethren eſcape, who go out of the Reach of the Cold a little before the Approach of Night.

Since therefore the ſame Air, in different States of Heat and Cold, affects Vapour in this Manner, it thence follows, that Vapour, wafted from Air of one Temperament to another, muſt be affected in the ſame Manner alſo: So that Vapour, carried from a colder to a warmer Air, will aſcend; and, on the contrary, Vapour carried from a warmer to a colder Air, will deſcend.

Now if Cold condenſes the Air, and thereby makes it preſs upon the warmer; and if Vapour, carried by a Stream of Air from a colder to a warmer Region, aſcends; we have the Reaſon why the N E blows, and why it blows dry.

Let us fix upon ſome Spot in the Continent of *North-Europe*, whence this Wind comes to us: Suppoſe *Archangel*, which lies on our N E

Point and is in 65° N Lat. When the Froſt is intenſe, the incumbent Air there muſt needs be very heavy; that Air will preſs every Way: *Quà data porta, ruit.* Let us conſider which Way this condenſed Air can burſt out from thence: It cannot go to the N, where the Cold is greater; nor to the E, for the Air over the large Continent of *Tartary* is at leaſt of equal Coldneſs with itſelf. I make no doubt but they complain at *Archangel*, in their Turn, of Cold N and N E, and even E Winds, as much as we do here. The great Continent to their S muſt be ſo cold as to make a ſtrong Reſiſtance: To the W, the Air might find a free Paſſage over the Ocean, were not the Colds of *North-America* too near. The main Outlet is between both, towards the *Atlantic Ocean*: The warm Air over which being able, of itſelf, to make but a feeble Reſiſtance, yields to the ſuperior Force; the Conqueror eagerly purſues his Victory, and we, happening to lie directly in the Way, feel then a cold dry N E Wind: This is the Wind that brings us Froſt in the Winter. When the Winter is ſevere, it continues to blow all the Spring, and it's Influence reaches to the End of the Summer.

This, I think, ſufficiently proves, that Air, flowing from a cold to a warmer Quarter, will blow dry: But, like a willing Witneſs, it proves too much; for, if Wind proceeds only from cold Air preſſing upon hot, and if Heat makes the Vapour aſcend, it follows from thence, that Wind can never bring Rain; whereas we find the contrary by ſad Experience; the S W Wind hath ruled theſe two Years, and ſtill doth rule.

How can this be accounted for, upon the Principles commonly received? That Vapour, wafted from a warmer to a colder Region of Air, ſhould precipitate, is what I have already ſhewn. But the Queſtion is, which I have not as yet ſeen anſwered, Why does the S W blow? What is the Cauſe why a Stream of Air ſhould be carried, for ſo long a Time, and with ſo great Violence, as we have often felt, from a warmer to a colder, from a rarer to a denſer, from a lighter to a heavier Quarter? To the N E of us lies the Continent of *North-Europe*, great Part of which is, in the Winter, deprived of the Sun's Heat, and conſequently very cold; on the other Side, to the S W, lies the vaſt *Atlantic Ocean*. We find by Experience, that the Sea ſhore is warmer than the Inland; that the Sea is warmer than the Shore; and that the Ocean is ſtill warmer than the Sea. Beſides, the more you go from hence towards the S, the nearer you go to the Sun; and the more N, the farther from it: This muſt make the S W Ocean much warmer than the Continent, that lies at an equal Diſtance, on the oppoſite Point: From this very warm Place, the Wind blows to a Place much colder; and yet there muſt be a natural Cauſe of all this apparent Contradiction to the Laws of Nature: Whether we can find it out or not, I ſhall attempt it as well as I can.

It will be in vain to ſeek for the Cauſe of this Wind in this Ocean itſelf, or in the Air over it, influenced only by the Sun, and the Surface of the Sea. But there may be *Tornados* in thoſe Seas: Our Seamen often meet them between the Tropics, ſeldom, as I am told, in the Ocean I am

now

now ſpeaking of, which is to the N of the Northern Tropic. But were they more frequent and violent than they really are, yet they are not laſting, and therefore cannot produce a long ſteady Courſe of S W Winds with us.

My Conjecture is, that our S W Wind is no other than an Eddy of the Trade-wind, reflected from *America* to us. Though we cannot ſee the Eddy of Air, as we do that of Water; yet we muſt be otherwiſe very ſenſible, that it makes a ſtrong Recoil, when it meets with lofty Buildings, Woods, Hills, *&c.* The more elaſtic any Body is, it rebounds with the more Agility; and the Experiments that have frequently been made, ſufficiently ſhew the vaſt Elaſticity of the Air. There can, I think, be no Difficulty in conceiving, that there may be an Eddy of Wind from that Part of *America* which lies under the Equinoctial Line, even to us, provided there be a ſufficient impelling Force, and due Reſiſtance, and a proper Direction.

The impelling Force is a ſteady briſk Stream of Air flowing perpetually from *Africa* to *America*: The Strength of this Wind may be in ſome meaſure judged of, from what Sailors obſerve, and expreſs in their Language, thus: It commonly blows a good Top-ſail Gale, as we ſail large; and if we were to ſail on a Wind, our lower Sails would be enough. I am ſenſible of what every Map ſhews us now, that the Trade-wind does not blow exactly from E to W: But though the Arrows are placed as if ſhot obliquely towards the Equinoctial, or rather towards a Line parallel to it, and diſtant from it between 4 and 12 Degrees N Lat. yet they are all pointed Weſtward; and that, I preſume, will be as much to the Purpoſe I am upon, as if the whole Stream went due W.

In order to gueſs at the Momentum of this repelling Force, we ſhould conſider the Breadth and Height of that Part of the Trade-wind, which I ſuppoſe to be turned this Way.

With Regard to the Breadth, I read in *Dampier*, that they meet the Trade-wind at about 30° on this Side the Line; as many Degrees on the other Side will make the Whole extend to 60° broad. Methinks I do not want ſuch a Breadth, nor indeed can I fairly expect it. For ſo much of this Wind as blows to the S of the moſt Eaſtern Point of S *America*, which I think, is called *Cape St Auguſtin*, ſhould turn off ſouthward; the reſt, which blows to the N of that *Cape*, I may lay Claim to. This *Cape* is in about 8° S Lat. ſo that I may demand a Breadth of 38°; but I will make an Abatement: For though the Trade-wind, to the N of the Line, be ſometimes 30° broad, yet ſometimes it is not above 24°; which Variation depends, as I ſuppoſe, on the Sun's Place in the *Zodiac*: So that it is narroweſt in the Winter, and wideſt in the Summer. Taking it then at the narroweſt, when the Sun is in the Winter Solſtice, we ſhall have a Breadth of 32°: But I allow 2°, to make Amends for the ſlack Wind, to the North of the Tropic of *Cancer*, and for the Calms near the Equator; and inſiſt on 30° only for the Breadth of that Trade-wind, which is to be reflected back to us.

How

How high ſoever that Column of Air be, which is carried through this wide Space, no more of it can affect us, than what is repelled by the Hills it ſtrikes againſt, and by the cold Air which hangs over them.

I take theſe high Lands, and their incumbent Air, to be a Reſiſtance ſufficient to repel the Trade-wind: The Land muſt needs be ſo to it's Height; and the Air over it, being many Degrees colder than the Trade-wind, will make a Reſiſtance in Proportion to it's ſuperior Weight. How high this Reſiſtance may be, I cannot pretend to determine: If I require no more than 3 Miles from the Surface of the Sea to the Top of the higheſt Ridge of Hills, within the Tract I am now ſpeaking of, and to the cold Air above them, I think I make but a modeſt Demand. Here, then, we have a Gale of Wind of the Breadth of 30°, 3 Miles high, carried with a great Velocity from *Africa* to *America*, a Momentum more than ſufficient to drive the Air from *America* to us, if there be but a proper Direction.

Were the whole Stream of the Trade-wind like a Mathematical Line, mere Length, without Breadth, and were this ſtrait Line to ſtrike on a ſmooth Surface of a given Inclination, we could know it's Direction exactly. For it is a Rule in Geometry, that the Angle of Reflection is equal to the Angle of Incidence. Suppoſe, for Example, that the Line of Trade-wind blew juſt S E, as it is ſaid to do, S of the Equator; that the Surface it ſtruck againſt ran exactly from S to N, as the Hills of *Peru* do; and that the Point of Incidence were under the Equator; in this Caſe the Angle of Incidence will be half a Right Angle, or an Angle of 45°, and conſequently the Angle of Reflexion will be 45°: Now, as theſe Degrees, when the reflected Line ſhall have run 90° in Length, will be equal to Degrees of a great Circle, and as we are about 90° E of this ſuppoſed Place of Contact, therefore this reflected Line will, in our Longitude, reach to 45° of N Lat. which is about *Bordeaux*. If we ſhould ſuppoſe the whole Breadth of the Trade-wind to conſiſt of an infinite Number of parallel Lines, falling on a Surface of the ſame Inclination, then the reflected Lines will be all parallel, and conſequently the Angles will be all equal; but they will reach wider, according to the Diſtance of one Point of Contact from the other; ſo that if that Line, which fell on the ſuppoſed Surface under the Equator, be reflected to 45° N Lat. that which fell on the ſame Surface to the N of the Equator, ſuppoſe in 23° S Lat. will reach to 68° N Lat. which is to the N of the *Orcades*, and almoſt to the N Cape of *Norway*. Or if we ſuppoſe the Trade-wind to the N of the Equator, to flow directly N E as it is alſo ſaid to do, and to ſtrike againſt a Surface inclining from S E to N W, which is pretty near the Bearing of the *Iſthmus* that joins N and S *America*; in both theſe Caſes the Reflexion will be towards the N E.

But there is no depending on this way of calculating: Not that God does not act according to the exacteſt Rules of Geometry, in the Motion of the Winds, as well as in all other Parts of the Creation: But we do not know, at leaſt I am far from pretending to know, all the infinite

Variety

Variety of Reverberations that the Wind muſt have, from the uneven Surfaces it ſtrikes againſt, between Cape *St Auguſtin* and the Bottom of the Gulph of *Mexico*. I make no doubt but that different Parts of this Air are reflected a thouſand different Ways; and yet that the whole afterwards unite, or the far greater Part, and flow this Way. I find myſelf under a Neceſſity of ſuppoſing what I cannot demonſtrate Mathematically, ſince I can aſſign no other Cauſe why the S W Wind blows ſo long with us.

But there are ſome other Facts which ſtrongly ſupport my Hypotheſis; *viz.* Currents of the Sea, and the Wind in the *Atlantic* Ocean, to the N of the Trade-wind.

With Regard to the Currents, *Dampier* tells us, it is generally obſerved by Seamen, that, in all Places where the Trade-wind blows, the Current moves the ſame Way with the Wind; and that though it be perceived moſt near the Shore, yet it makes no ſenſible Riſing in the Water, as the Tides do. He ſays, there is always a ſtrong Current ſetting from Cape *St Auguſtin* Weſtward, occaſioned, as he remarks, by the S E Trade-wind driving the Surface ſlanting on the Coaſt of *Braſil*; which, being there ſtopped by the Land, bends it's Courſe Northerly, towards Cape *St Auguſtin*; and, after it has doubled that Promontory, it falls away towards the *Weſt-Indies*, down along the Coaſt Weſtward, till it comes to Cape *Gratia de Dios*; from thence N W towards Cape *Catoch* in *Jucatan*, thence to the Northward between *Jucatan* and *Cuba*. He ſays, that in the Chanel, between *Jucatan* and *Cuba*, he has found the Currents extraordinary ſtrong; that it is probable, that the Current which ſets to Leeward, on all the Coaſt from Cape *St Auguſtin* to Cape *Catoch*, never enters the Bay of *Mexico*, but bends ſtill to the Northward, till it is checked by the *Florida* Shore; and then wheels about to the E, till it comes near the Gulph's Mouth, and paſſes with great Strength through the Gulph of *Florida*, which is the moſt remarkable Gulph in the World for it's Currents, becauſe it always ſets very ſtrong to the N.

Thus far this Pilot: And, if too great a Fondneſs for my own Conjecture does not prejudice me very much, I may venture to ſay, that theſe Obſervations ſtrongly confirm it. He takes notice of the firſt Current which the Trade-wind makes near the Shore at Cape *St Auguſtin*, where it is ſtrong; thence he traces it from one Cape to another, as it winds about by different Directions, yet ſtill gathering Strength at every Turning: It is extraordinary ſtrong between *Jucatan* and *Cuba*, but ſtrongeſt at the End of it's Courſe in the Gulph of *Florida*. This Acquiſition of Strength upon a new Direction, is contrary to the Laws of Motion; therefore it muſt be owing to a freſh Supply, which the reſt of the Current, cauſed by the Trade-wind, gives it, till at length the whole Power, joined together, ruſhes out into the *Atlantic* Ocean.

Let us then ſuppoſe the Wind, which drives this Water before it, to follow it much in the ſame Courſe; and that, inſtead of ſtriking againſt one plain Surface, with ſuch an Inclination as would direct it to us, it

ſtrikes

ſtrikes againſt a Million, yet ſtill bending this Way: Let this natural Suppoſition be admitted, and we have the very Thing ſought for, *viz.* a proper Direction.

The other Fact is this: That when our Ships return from the *Weſt-Indies* through the Gulph of *Florida*, and are got into the wide Ocean, they have a regular Wind at S W, or near that Point, which ſometimes attends them to their very Port. This Wind cannot have it's Riſe in that Ocean, nor can it come from any Continent that lies to the North, or even Weſt of it; therefore I conclude, that it muſt be an Eddy of the Trade-wind.

But to all this it may be objected, that the Sea-current ſets out of the Gulph of *Florida* towards the N; whereas, I ſay, the Wind comes towards the N E. Sailors, it ſeems, take no farther Notice of theſe Currents, than while they are near Head-lands, where they are ſtrongeſt, and affect their Navigation moſt. But there ſeems to me to be a Neceſſity of the Continuance of this Current much farther than the Gulph of *Florida*, and of it's taking new Directions from the N towards the N E, and thence even towards the S, before it be quite ſpent. For it muſt be a vaſt Quantity of Water that is driven by the whole Breadth of the Trade-wind, from *Africa* to the Shores of *America*; the far greater Part of which, as *Dampier* ſuppoſes, doth flow by the Promontory of Cape *St Auguſtin* Weſtward. This great Flux of Water has found a Paſſage out towards the N, between *Florida* and *Cuba*; which is the Reaſon, that, notwithſtanding the Current ſets Weſtward, the Sea in the *Weſt-Indies* never riſes. Here we ſee, that the Middle Ocean is at a great and conſtant Expence of Water; it muſt therefore want a Supply, and no Supply ſo natural, as for it to have it's own Water again; which, after it hath paſſed the Gulph of *Florida*, meets with one Check ſtill after another, till it returns to the Place from whence it came.

For the ſame Reaſon we may ſuppoſe, that though the Eddy of the Trade-wind ſhould be reflected due North, from the Land it firſt ſtrikes againſt; or even though it ſhould undergo as many Turnings as the Surface of the Sea it drives before it; yet it may take a new Direction in the Ocean, cauſed by the Winds that blow from the Continent of *North America*.

Another Objection may be made againſt the S W Wind being an Eddy of the Trade-wind, from what I myſelf have advanced, *viz.* that Cold is the Cauſe of Wind: That the *Atlantic* Ocean is too warm to produce this Wind; and yet that it comes from the Trade-wind, which blows between the Tropics, a Place much warmer: So that, according to this, here is a very warm Wind making it's Way againſt the Cold of the North.

That Wind will blow from a warmer to a colder Quarter, is confirmed not only from the S W raging with us in Winter, which muſt be confeſſed to come from a much warmer Climate, whatever Cauſe it be owing to; but from the almoſt daily Obſervation of thoſe who live

in the Country, and will look a little about them. Whoever is within the Sight of Hills, and there are few Places where there are not ſome in View, will find, if he takes the leaſt Notice, that it rains in the Hills before it rains in the Vales: What can be the Cauſe of this Rain? Nothing, doubtleſs, but a Wind blowing from the Vales towards the Hills; that is, from a warmer to a colder Region, where the Vapour, which is brought thither, falls. Suppoſe the Air over the Hills be cold in 20°, and the Air over the Vales but in 10°, 10 cannot outweigh 20; but, if it gets an additional Force of 30, it will then be double the Strength of 20; and, conſequently, blow from a warmer to a colder Quarter.

The *Momentum* of every Thing that moves, is made up of two Powers, Weight and Velocity, multiplyed by one another. This is fully ſhewn in the Butcher's Stiliard, which, with a Weight of 5 Pound, will weigh 100 Pound, by placing the 5 Pound Weight 20 times farther from the Centre, than the Thing to be weighed is placed: For 5 Pound the Weight multiplied by 20, the Velocity is equal to 100 Pound. Suppoſing then that the Cold to the N E of us be 100, and the Cold which drives the Trade-wind, only 5; that is, that the Cold of the one Place be 20 times greater than the Cold of the other: But ſuppoſing the Air 5° cold, to move 20 times faſter than that which is 100°; upon this Supposition the *Momentum* will be equal: And ſince they move in direct Oppoſition to one another, they will meet exactly half way, which I take to be ſometimes near the Caſe. But if the Northern Power ſhould loſe ½ it's Weight, *i. e.* be milder, by ½, one Winter than it is another, the other Power ſtill continuing the ſame, then the S W will blow one Half farther.

I am aware of but one Objection more, which is, that in the Gulph of *Florida*, through which I ſuppoſe the Trade-wind to flow towards us, there are variable Winds, which muſt interrupt this Stream, if there be any; ſince the ſame Air cannot flow different Ways at the ſame time.

It is no new thing to have variable Winds near the Land, even in the midſt of the Way of the Trade-wind. The Weſterly Winds, which, as *Dampier* ſays, blow on the Coaſt, between Cape *Gratia de Dios*, and Cape *La Vela*, are a Proof of it. The common Trade-wind on this Coaſt is between N E and E; but from *Oct.* till *March*, and chiefly in *Dec.* and *Jan.* the Winds blow W; and yet when they are longeſt and ſtrongeſt on the Coaſt, the Eaſterly Trade-wind blows off at Sea, as at other times. Near Cape *La Vela*, the true Trade blows within 8 or 10 Leagues off the Shore, when the Weſterly Winds blow on the Coaſt. This ſhews that theſe Land-winds reach but a little Way, and therefore can have but a ſmall, if any, Influence on the main Stream of the Trade-wind.

In ſmaller Navigations here in *Europe*, they find the Wind out at Sea different from what it is near the Shore, and eſpecially near Head-lands, where it generally blows hardeſt, and which helped to make the Navi-

gation

gation of the Ancients, in the *Mediterranean*, ſo tedious and dangerous, Theſe variable Coaſt-winds may be owing to great Snows, or Rains that fall upon High-lands, when there is none, or little, at Sea, or to ſome Storms of Thunder that burſt over them, or to their natural Coldneſs, or even to the Repercuſſion of the Air. I take the variable Winds they meet on the Coaſt of *Florida*, to be owing to the like Cauſes, which have their Influence but a little Way.

But it may be ſaid, that theſe variable Winds on the Coaſt of *Florida* are found ſo near the Trade-wind, that there is no Room between them for the Eddy of the Trade-wind, I am ſpeaking of, to paſs out. It may be Fact, for ought I know: I will ſuppoſe it to be Fact. But I deſire the Objector to conſider, that, when he is ſailing, he is on the Top of the Water, and at the Bottom of the Air; he perceives the Current of Water run very faſt at Top, but does not know how it runs at the Bottom. It is very certain, that there are Under-currents in Water: In Rivers that ebb and flow, it is perceived every Tide; for the Current will run up after it hath begun to ebb. By Experiments that have been made, it appears, that in ſome Places, where the Current on the Surface is very ſtrong, the Under-current, running quite the contrary Way, ſhall be much ſtronger, and carry away a Boat againſt the Force of the upper Current.

And why may there not be contrary Currents in the Air? An Element much more ſubtile than Water, and therefore capable of being put into a greater Variety of Motions. The Sailor concerns himſelf no farther with the Wind, than as it fills his Sails, the Height of which can bear but a ſmall Proportion with that Column of Air I am now ſpeaking of. The Land-breezes about Iſlands, in the Torrid Zone, ſhew different Currents in the Air. For, in the Night, the Wind ſhall blow from the Centre of the Iſland, every Way, into the Sea, and even in direct Oppoſition to the Trade-wind, and yet give no Interruption to the Progreſs of it, except juſt in that little Spot, and for a ſmall Height too; which is evident from hence, becauſe in ſailing to the Weſtward of *Barbadoes*, ſuppoſe, or *Jamaica*, without the Reach of the Land-breeze, you feel no Interruption in the Strength of the Trade-wind, by Night as well as by Day.

I, who am one of no great Obſervation, have frequently ſeen different Currents in the Air, at the ſame Time, and in the ſame Quarter, under one another. For Example: When the under Current has been E, the upper Current has been S W, and the middle S E. I ſhall appear ridiculous, if I ſay I ſee the Wind; the Vulgar think, that Swine only are endowed with that Quickneſs of Sight. I do not ſay, that I can ſee the Wind; but I have often ſeen Clouds, Weather-cocks, Smoke, and ſuch-like Things, that are either carried or turned by the Wind. Smoke and Vanes are ſo near, that they can hardly cauſe any Deception; ſome Clouds may, unleſs properly obſerved: For when there are two Tire of Clouds, both carried the ſame Way, and with the ſame Velocity, the

upper Tire ſhall appear to move directly contrary to the lower; which Deception is owing to the different Angles that Objects of the ſame Magnitude, at different Diſtances, make on the *Retina.*

The way to obſerve the Motion of the Clouds, is by looking at them and a fixed Object at the ſame time, as the Sun and Stars, ſometimes: The beſt ſuperior fixed Object is the Moon in her Quarters, which may be then ſeen by Day-light, without offending the Eye. The fixed Objects below the Clouds are, a Ridge of Hills, lofty Buildings, or, for want of them, a Tree. By obſerving a Cloud with any fixed Object, you will not only ſee on what Point of the Compaſs the Clouds paſs; but you will ſee alſo the Motion of the upper and under Current: By this means you will find, as the Caſe happens, either both Currents going the ſame Way, though with different apparent Velocity; or the upper Current going one Way, and the lower another, and perhaps you will ſee the Smoke going a Third. This ſufficiently ſhews, that there are different Currents in the Air.

From all my little Obſervation I find, that the upper Current generally prevails. For though the under Currents from, ſuppoſe, the E, or even N E, be briſk at firſt, and the briſker they are at firſt, the longer they continue; yet they die away by degrees, as their Strength ſpends itſelf; the Air becomes near calm, and then the S W, which before blowed aloft, deſcends to the Earth, and commands the whole Sky.

That the Diſorders of the lower Air do not affect the Stream above, appears alſo from the Trade-wind paſſing over the very Continent, from the E to the W Side of *America.* I make no doubt but the high Hills of *Peru* cauſe a greater Variety of Winds and Weather, than we have here. Their Weſtern Sea ſhews, that the lower Part of the Trade-wind meets with great Obſtructions in paſſing over the Continent. For, as *Dampier* obſerves, you do not meet with the true Trade-wind, till you are got 150 or 200 Leagues from Shore; and then it blows in it's uſual manner. If all the Diſturbance that the high Hills of *Peru*, ſaid to be the Higheſt in the World, give to the Trade-wind blowing over them, cannot intercept the upper Stream, which, after ſurmounting all thoſe Heights, and the Diſorder that their Cold occaſions, ſtoops down again, till it comes to touch once more the Surface of the Ocean; we may eaſily ſuppoſe, that that Part of the Trade-wind, which is reflected from theſe Hills towards the N E, may diſengage themſelves, in like manner, from all inferior Obſtructions, and fly over all the little low Diſorders of the *Floridan* Coaſt.

Upon the Whole, then, though I cannot pretend to find out the Angle of Incidence, yet I muſt conclude, that the Trade-wind is reflected in ſuch a manner as to cauſe our S W Wind.

And I conceive, that this new Direction is ſo far from checking it's Current, that it the rather increaſes it. For a great Part of the cold Air, that hangs over the Continent it ſtrikes againſt, having no other Vent, flies

off

off with the Eddy, and thereby makes more than Amends for the Stop it gave.

From *America* to the Weſt of *England* this Wind glides over the Ocean, a plain Field, that gives no Oppoſition, and which, with it's natural Warmth, encourages the Waft, by making the Air over it more ready to yield to the impelled Force.

Having thus opened a Paſſage for the Trade-wind to flow even to us, with a back Stream. if my Conjecture hath opened it; what I have ſaid may ſerve as a Hint to thoſe who have better Materials, and can make a better Uſe of them: But, admitting that my Conjecture is right, we have the Cauſe why the S W Wind blows with us; and then there can be no great Difficulty in finding out the Reaſon why it brings ſo much Rain.

For this Wind blowing over a warm Ocean, which ſends up many Vapours, by the time it reaches us, comes charged with an infinite Swarm of watery Bladders, which the Cold of this Climate condenſes, and then down they fall in Showers of Rain.

From hence it appears, that the two great Rulers of the Weather with us are the N E and S W Winds. Like two neighbouring potent Monarchs, they are engaged in eternal Wars: Sometimes the one puſhes his Conqueſt with great Rapidity; and ſometimes the vanquiſhed Power not only recovers it's loſt Dominions, but carries on the War into his Enemy's Territories with great Succeſs. As we happen to lie near their Frontiers, we feel, by turns, the different Effects of their fierce Contention: Some Years we have a Run of N E Winds, froſty Winters, and dry Summers; and ſome Years the Reverſe of all this.

But if I have hit upon the true Cauſes of theſe Winds, yet the Queſtion will be, On which Side lies the Redundancy, or Failure, that makes all this irregular Variation? For, between two Antagoniſts, the Advantage will be the ſame to the Conqueror, whether his Superiority be owing to his own Strength, or the Weakneſs of his Adverſary, I would be glad to find this out, but I doubt that all my little Search will not be able to do it. I will proceed as far as I can.

Let us ſuppoſe, in the firſt Place, the N to be entirely paſſive, and that all the Variation of Cold and Heat is owing wholly to a Defect, or Exceſs, in the S W Wind: So that, when the S W blows, it ſhall be always warm; and, when it ceaſes to blow, it ſhall be ever cold. If this be Fact, then it will follow, that whilſt the S W blows with the ſame ſteady Gale, the Weather ſhall be of the ſame Degree of Heat: But we find it otherwiſe; for the Nights, in a mild Winter, are colder than the Days, the ſame S W ſtill blowing; therefore Cold, with us, is not wholly owing to a Slackneſs of the S W Winds.

Let us now ſuppoſe the Privation of the Sun's Heat to be the only Cauſe of Cold: The Conſequence will be, that all Places equally diſtant from the Sun, will be equally cold. But it is well known, that, in the ſame N Lat. in *Europe*, Cold is greater on the Continent than in Iſlands;

Iſlands: Therefore Privation of the Sun's Heat is not the only Cauſe of Cold. The Sun's Abſence, like other negative Cauſes, can amount only to the Removal of an Obſtruction which hindered the efficient Cauſe of Cold, whatever it be, from acting.

Since the larger the Tract of Earth, the greater the Cold, the efficient Cauſe of Cold ſeems to be in the Earth; and yet, when we deſcend a little Way under-ground, not only in Mines, but in ſome Cellars, we find an even Temperament: We muſt therefore confine this efficient Cauſe of Cold to the Earth's Surface.

But if the Earth's Surface be the ſole efficient Cauſe of Cold, ſince the Surface of the Earth ſtill continues the ſame, the Cold ſhould be the ſame on that Surface every Winter; whereas we find it otherwiſe. We muſt, therefore, ſeek for ſome concurrent Cauſe, between whom and the Earth's Surface this Cold is generated; and that, I think, can be no other than what is carried on the Wings of the Wind.

Dampier obſerves, that, after a *Tornado* at Land in *Jamaica*, the Land-wind will begin by 4 or 3 in the Afternoon. The Materials of this *Tornado* muſt be carried thither by the Wind; where the *Tornado* burſts, it cools the Air; which makes the Land-breeze begin ſome Hours ſooner than it's uſual Courſe.

That the S W Wind, warm as it is, carries with it the Seeds of Cold, is evident from thoſe violent Storms of Thunder, attended with great Rains, and large Hailſtones, ſeveral of which happened this laſt Summer.

The 8th of laſt *Sept.* was a cold Winter's Day at the Place where I dwell. In the Morning, when I awoke, I perceived a great Dew on the Inſide of the Glaſs of my Chamber-window: When I went out, I obſerved the Wind to be N E, ſtrong, black Clouds, and little Rain early, reſt dry. 9th in the Morning, the Wind was N E, briſk, dry. I began to think, that the Winter was going to ſet in very ſevere; but I was in a little time undeceived. The Afternoon of the 9th was overcaſt. On the 10th, I ſaw Colts-tails, as the Sailors call them: I take them to be *Virgil*'s *Tenuia lanæ vellera:* Marks of Rain, that ſeldom deceive thoſe who are uſed to obſerve them. On the 11th, the Wind returned again to it's old Point of S W, with Rain. Some time after, I did read in the News-papers, that on the 7th a violent Storm fell about *Worceſter*, which is diſtant from hence about 2 Degrees, and bears, nearly, on the N E Point. Then I found out the Cauſe of that little Winter.

I could mention more Facts of this Kind, but theſe, I believe, are enough to ſatisfy us, that the Seeds of Cold are carried on the Wings of the Wind. It will be needleſs to take notice, that the Wind carries the Cold back again: Every one who feels his Hands tingle in a froſty Morning, and looks at the Weather-cock, muſt be ſenſible of it.

Since, therefore, a large Surface of Earth to the N of us, aſſiſted only with a Privation of the Sun's Heat, cannot produce Cold to ſo great a Degree, as to affect the Weather with us; and ſince it appears, that that

which

which is to help these two Causes to produce such a Cold, is brought by the Winds, and carried off again; I must conclude, that there are frigorific Particles floating in the Air, whether they be Nitre, or by whatever Name the Chymists will call them; that they are always acting, unless obstructed by other Causes; and that, when they find a proper Recipient, and all Obstructions be removed, they act with Vigour.

When I speak of the Seeds of Cold, I do not mean, that Cold acts as a Vegetative: Though whoever considers the Order that Frost observes in building it's Ice upon the Water, will be apt to think, that if it be not the Effect of Vegetation, it is something that resembles it very near.

It first shoots out a small strait Twig; then, from the same Centre, one on each Side; from these main Beams dart out smaller Sprigs on each Side, to form the Contignation; then these Rafters sending forth their Sprays, the whole Floor is laid, weak at first; but as they gather Strength, they make a Plancher, strong enough, sometimes, to bear the Weight of whole Armies passing over the *Baltic*.

I do not expect, that the Ladies will expose themselves so much to the Cold, as to see all this: But if they please to give themselves only the Trouble to look on their Chamber-windows in a Frosty Morning, if they rise soon enough, they will see there such Embroidery made by Ice, as their own Fingers, were they used to work, and the finest Needles, could not equal.

All this, I say, would tempt one to imagine, that there is something vegetative in what I call the Seeds of Frost. But that is not what I am about at present. All I contend for now is, that that which co-operates with the Earth's Surface, to produce Cold, which way soever it produces it, is carried to and fro by the Air.

Instead of their acting like Seeds, let us suppose them to act like inanimate Bodies: That each Particle acts with a determined Force; and that, consequently, the more of them act together, the greater their Effect. Upon this Supposition we can easily account for the different Temperament of the Air in the same Seasons. For a Continuance of N E Winds for some Years will carry off many of these Seeds, or Grains of Cold; and an equal Continuance of S W Winds will bring them back again; and these Periods will be longer or shorter, according to the Strength or Weakness of the Blast.

And thus, at length, I have satisfied myself, till I can find out a better Reason, why a cold frosty Winter produces a dry Summer; and a mild Winter a wet Summer. For these Seeds of Cold being the chief Cause of Frost, and their Strength being in Proportion to their Number, when the Winter is severe, there is so vast a Quantity of these frigorific Particles in *North-Europe*, that their Strength will not soon be exhausted; and, consequently, that the N E Winds will blow long, and make the Summers dry.

But,

But, on the contrary, when the Winter is mild, there are but a few of thoſe Particles in *North-Europe*, not enough to cool the Air there to ſuch a Weight, as to enable it to hinder the S W from reaching us, even in Winter; and therefore, when once the Sun's Heat comes to deſtroy thoſe few, the South-weſt, which is always acting with equal Force, prevails, and brings Rain in Summer.

I make no doubt, but that a Courſe of Obſervations, kept for ſome Years, in ſeveral Places, would reduce the Knowledge of theſe Viciſſitudes of Wind and Weather to ſome Certainty.

I have taken notice only of two Winds, the North-eaſt and South-weſt, as the Producers of a long Run of dry or wet Weather: But if I have hit upon the true Cauſes of thoſe Winds, the ſmaller Variations may be eaſily accounted for. I ſhall mention a few.

Next to thoſe Two, the N W Wind blows longeſt here, and with the greateſt Force, but with various Effects. Sometimes it conſpires with the South-weſt, to blow a mere Storm, with hard Rain; and ſometimes it takes part with the North eaſt, blows dry, and freezes. We are, in a great meaſure, beholding to this Wind, for the little dry Weather we have in a mild Winter.

I take this Wind to proceed from the Continent of *North-America*, where the Cold muſt needs be very intenſe, that can drive the Air from thence hither, with ſuch ſtrong Guſts. It is well known, that Places of the ſame N Lat. are much colder in *America* than in *Europe*. Upon Suppoſition that the N W Wind blows from *N America*, I can, methinks, eaſily account for all theſe contrary Effects produced by the ſame Wind.

Though it blows from a cold to a warmer Quarter, yet it brings Rain at firſt, for this Reaſon, becauſe the Air over the Ocean about us is warmer than that over us. When the N W begins to blow, it muſt drive the Air before it; and then the Vapour that floated in warm Air will fall down with us. Even the N E, the drieſt and coldeſt Wind we have, will bring Rain, and for many Hours, when it ſets in after a South-weſt.

Hence alſo it is that the S E and S Winds bring much Rain, and for many Hours together. I take the S E to come from the *Alps*, and the South from the *Pyrenees*.

I ſhall, at preſent, run no farther into Particulars; my Deſign being only to inquire into the Cauſes of a long Continuance of dry or wet Weather. It would be endleſs to enter into all the Predictions of Weather, that may be collected from Books, and private Obſervations: Moſt of them pretend to foretel the Weather no farther than a few Days. If thoſe Predictions and my Hypotheſis be founded on Nature, they will all admit of the ſame, or of a conſiſtent Explanation.

N. F. Dec. 31. 1735.

XIX. The

Concerning the Storm Jan. 8*th* 1734-5, *by Mr* Henry Forth, *dated* Darlington, Jan. 18, 1734-5.

XIX. The Place from which I write, and where I reſide, is 14 Miles South of *Durham*, Lat. 54° 46′. The Evening before the 8th, my Barometer ſtood at 29 Inches, but had been gradually falling for two Days. The Wind was then S W high in the ſecond Degree; which increaſed towards Midnight a Degree more. Moſt of the Day was attended with Snow or Sleet.

The 8th in the Morning I found my Glaſs fallen to 28 Inches, 38 Parts, and at 4 *p. m.* down to 28 Inches, 5 Parts, and by 10 *p. m.* riſen again to 28 Inches 45 Parts. All this while the Wind with us was in the N E, with only a moderate Gale, tho' attended all Day with Snow, which at Night was 2 ¼ Inches deep; and about 8 it began to freeze. As the Wind in the South Parts was all that while in the oppoſite Quarter, I ſhould have expected an Accumulation of the Air, and, as a Conſequence, the riſing of the Barometer at the time of it's falling the loweſt. Had the Storm been the Night before, when our Wind was in the ſame Direction, and had afterwards fallen, I ſhould then have imputed the Fall to the quick Return of the Current of Air to reſtore the Æquilibrium: But as it is, the ſmall Progreſs I have made in *Natural Philoſophy*, leaves me in Ignorance.

P. S. As we have been fortunate in eſcaping the laſt Storm, we have been no leſs ſo in Regard to the melancholy Effects which the great Rains have produced in the more Southerly Parts; for tho' we had more than uſual with us the laſt Month (for I find by my Regiſter that 13 lb 85 Pts. fell through my Funnel, whoſe Area is juſt 100 Inches, in *Dec.* laſt) yet the almoſt conſtant intermitting Froſts we had, kept it from going off in any conſiderable Quantity at a time.

		Inches.
Barometer,	greateſt Altitude — —	30 : 10
	leaſt ditto — — —	29 : 13

Concerning a violent Hurricane in Huntingtonſhire, Sept. 8. 1741. *By Mr* Stephen Fuller, *Fellow of* Trin. Coll. Cambridge. No. 461. p. 851. *dated* Cambridge, Sept. 9. 1741.

XX. Yeſterday was the moſt violent Hurricane of Wind in theſe Parts, that ever was known ſince the Memory of Man. *Cambridge* was not in the midſt of the Hurricane, ſo that it has eſcaped very well. I happened to be paying a Viſit to Dr *Knight*, at *Bluntſham* in *Huntingtonſhire*, about 10 Miles N W of *Cambridge*. We were in the midſt of the Hurricane; but, by getting into the ſtrongeſt Part of the Houſe, we eſcaped without any great Danger. The Morning, till half an Hour after 11, was ſtill, with very hard Showers of Rain: At half an Hour after 11 it began to clear up in the S, with a briſk Air, ſo that we expected a fine Afternoon: The S W cleared up too, and the Sun ſhining warm drew us out into the Garden. We had not been out above 10′, before we ſaw the Storm coming from the S W: It ſeemed not to be 30 Yards high from the Ground, bringing along with it a Miſt, which rolled along with ſuch incredible Swiftneſs, that as near as we could gueſs, it ran a Mile and an half in half a Minute: It began exactly at 12 o'Clock,

and laſted about 13′, eight Minutes in full Violence: It preſently untiled the Houſe we were in, and ſome of the Tiles, falling down to Windward, were blown in at the Saſhes, and againſt the Wainſcot on the other Side of the Room; the broken Glaſs was blown all the Room over, the Chimnies all eſcaped; but the Statues, which were on the Top of the Houſe, and the Baluſtrades from one End to the other, were all blown down. The Stabling was all blown down, except two little Stalls. All the Barns in the Pariſh, except thoſe that were full of Corn quite up to the Top, were blown flat upon the Ground, to the Number of about 60. The Dwelling-houſes eſcaped to a Miracle; there were not above a Dozen blown down out of near 100. The Alehouſe was levelled with the Ground; but by good Luck not a Soul in it. If the Storm had laſted 5′ longer, almoſt every Houſe in the Town muſt have been down; for they were all, in a manner, rocked quite off from their Underpinnings. The People all left their Houſes, and carried their Children out to the Windward Side, and laid them down upon the Ground, and laid themſelves down by them; and by that means all eſcaped, but one poor Miller, who went into his Mill to ſecure it againſt the Storm, and was blown over, and cruſhed to Death betwixt the Stones and one of the large Beams: I ſaw him taken out. All the Mills in the Country are blown down: I do not hear of any more bodily Miſchief; only one Miller at *Willingham*, ſo much bruiſed, that they hardly expect his Life. Hay-ſtacks and Corn-ſtacks are ſome quite blown away, ſome into the next Corner of the Field. The Pigeons, that were catched in it, were blown down upon the Ground, and daſhed to Pieces; one of which I found, myſelf, above half a Mile from either Houſe or Hedge. Wherever it met with any boarded Houſes, it ſeemed to exert more than ordinary Violence upon them, and ſcattered the Wrecks of them for above a quarter of a Mile to the N E, in a Line: I followed one of theſe Wrecks myſelf; and, about 150 Yards from the Building, I found a Piece of a Rafter, about Feet long, and about 6 Inches by 4, ſtuck upright 2 Feet deep in the Ground; and at the Diſtance of 400 Paces of my Horſe, from the ſame Building, was an Inch Board, 9 Inches broad, 14 Feet long: I am convinced, that theſe Boards were carried up into the Air; for I ſaw ſome, that were carried over a Pond above 30 Yards; and I ſaw a Row of Pales, as much as two Men could lift, carried 2 Rods from their Places, and ſet upright againſt an Apple-tree. Pales, in general, were all blown down, ſome Poſts broke off ſhort by the Ground, others torn up by the Stumps. The whole Air was full of Straw: Gravel-ſtones, as big as the Top of my little Finger, were blown off the Ground in at the Windows; and the very Graſs was blown quite flat upon the Ground. After the Storm was over, we went out into the Town, and ſuch a miſerable Sight I never ſaw: The Havock I have deſcribed; the Women and Children crying, the Farmers all dejected; ſome bleſſing GOD for the Narrowneſs of their Eſcape, others wondering how ſo much Miſchief could be done with one Blaſt of Wind, which

hardly

hardly laſted long enough for People to get out of their Houſes. I talked to two People, that were out in it all the Time, who ſaid, that they heard it coming about half a Minute before they ſaw it; and that it made a Noiſe ſomething reſembling Thunder, more continued, and continually increaſing. I ſaw a Man in the Afternoon, who came from *St Ives*, who ſays, the Spire of the Steeple, which is one of the fineſt in *England*, is blown down, as is the Spire of *Hemmingford*, the Towns having received as much Damage as *Bluntſham*. There was neither Thunder nor Lightning with it, as there was at *Cambridge*, where it laſted above half an Hour, and conſequently was not ſo violent. Some few Booths in *Sturbridge-Fair* were blown down. The Courſe of the Storm was from *Huntington* to *St Ives*, *Erith*, between *Wiſbich* and *Downham* to *Lynn*, and ſo on to *Suetſham*: We have heard nothing of it farther to the S W than *Huntington*, nor farther N E than *Downham*. Very few Trees eſcaped: The Barns that ſtood the Storm, had all their Roofs more damaged to the Leeward Side than to the Windward. We are in great Hopes the Storm was not general; I am apt to think it was much ſuch a Storm as ran through *Suſſex* about 10 Years ago. The Storm was ſucceeded by a profound Calm, which laſted about an Hour; after which the Wind continued pretty high, till 10 o'Clock at Night.

Concerning a terrible Whirl-wind, which happened at Corne Abbas *in* Dorſetſhire, Oct. 30. 1731. *by Mr* J. Derby. No. 454. p. 229. July, *&c.* 1739.

XXI. About a Quarter before one in the Night, there happened a very ſudden and terrible Wind Whirl-puff, as I call it: Some ſay it was a Water-ſpout, and others a Vapour or Exhalation from the Earth; but be it of what Name it will, it began on the S W Side of the Town, carrying a direct Line to the N E, croſſing the Middle of the Town in Breadth 200 Yards. It ſtripped and uncovered tiled and thatched Houſes, rooted Trees out of the Ground, broke others in the midſt of at leaſt a Foot ſquare, and carried the Tops a conſiderable way. The Sign of the new Inn, a Sign of 5 Foot by 4, was broken off 6 Foot in the Pole, and carried croſs a Street of 40 Foot Breadth, and over an oppoſite Houſe, and dropped in the Backſide thereof. It took off and threw down the Pinacles and Battlements of one Side of the Tower; by the Fall of which, the Leads and Timber of great Part of the North Alley of the Church was broken in. The Houſes of all the Town were ſo ſhocked, as to raiſe the Inhabitants; no hurt was done but only acroſs the Middle of the Town in a Line. No Life loſt, but three had a very providential Eſcape. 'Tis computed by judicious Workemen, that the Damage ſuſtained by this Accident amounts to 258 Pounds, and upwards. It is very remarkable, it only affected, as I have related: no other Parts of the Neighbourhood or Country ſo much as felt or heard it. It is ſuppoſed by the moſt Judicious, that it began and ended within the Space of 2′. It was ſo remarkably calm a Quarter after 12, that the Exciſeman walked through 2 Streets, and turned a Corner, with a naked lighted Candle in his Hand, unmoleſted and undiſturbed by the Air; and as ſoon as over, a mighty Calm, but ſoon followed by a prodigious violent Rain. *Mintern Magna, Nov.* 13. 1731.

Concerning the Cauſe of the General Trade-Winds: By Geo. Hadley, *Eſq; F. R. S.* No. 437. p. 58. April &c. 1735.

XXII. I think the Cauſes of the General Trade-winds have not been fully explained by any of thoſe who have written on that Subject, for want of more particularly and diſtinctly conſidering the Share the diurnal Motion of the Earth has in the Production of them: For although this has been mentioned by ſome amongſt the Cauſes of thoſe Winds, yet they have not proceeded to ſhew how it contributes to their Production; or elſe have applied it to the Explication of theſe Phænomena, upon ſuch Principles as will appear upon Examination not to be ſufficient.

That the Action of the Sun is the original Cauſe of theſe Winds, I think all are agreed; and that it does it by cauſing a greater Rarefaction of the Air in thoſe Parts upon which it's Rays falling perpendicularly, or nearly ſo, produce a greater Degree of Heat there than in other Places; by which means the Air there becoming ſpecifically lighter than the reſt round about, the cooler Air will by it's greater Denſity and Gravity, remove it out of it's Place to ſucceed into it itſelf, and make it riſe upwards. But it ſeems, this Rarefaction will have no other Effect than to cauſe the Air to ruſh in from all Parts into the Part where 'tis moſt rarefied, eſpecially from the N and S, where the Air is cooleſt, and not more from the E than the W, as is commonly ſuppoſed: So that, ſetting aſide the diurnal Motion of the Earth, the Tendency of the Air would be from every Side towards that Part where the Sun's Action is moſt intenſe at the Time, and ſo a N W Wind be produced in the Morning, and a N E in the Afternoon, by Turns, on this Side of the Parallel of the Sun's Declination, and a S W and S E on the other.

That the perpetual Motion of the Air towards the W, cannot be derived meerly from the Action of the Sun upon it, appears more evidently from this: If the Earth be ſuppoſed at Reſt, that Motion of the Air will be communicated to the ſuperficial Parts, and by little and little produce a Revolution of the Whole the ſame Way, except there be the ſame Quantity of Motion given the Air in a contrary Direction in other Parts at the ſame Time, which is hard to ſuppoſe. But if the Globe of the Earth had before a Revolution towards the E, this by the ſame means muſt be continually retarded: And if this Motion of the Air be ſuppoſed to ariſe from any action of the Parts of it on one another, the Conſequence will be the ſame. For this reaſon it ſeems neceſſary to ſhew how theſe Phænomena of the Trade-Winds may be cauſed, without the Production of any real general Motion of the Air weſtwards. This will readily be done by taking in the Conſideration of the diurnal Motion of the Earth: For, let us ſuppoſe the Air in every Part to keep an equal Pace with the Earth in it's diurnal Motion; in which Caſe there will be no relative Motion of the Surface of the Earth and Air, and conſequently no Wind; then by the Action of the Sun on the Parts about the Equator, and the Rarefaction of the Air proceeding therefrom, let the Air be drawn down thither from the N and S Parts. The Parallels are each of them bigger than the other, as they approach to the Equator, and the Equator is

bigger

bigger than the Tropicks, nearly in the Proportion of 1000 to 917, and conſequently their Difference in Circuit about 2083 Miles, and the Surface of the Earth at the Equator moves ſo much faſter than the Surface of the Earth with it's Air at the Tropicks. From which it follows, that the Air, as it moves from the Tropicks towards the Equator, having a leſs Velocity than the Parts of the Earth it arrives at, will have a relative Motion contrary to that of the diurnal Motion of the Earth in thoſe Parts, which being combined with the Motion towards the Equator, a N E Wind will be produced on this Side of the Equator, and a S E on the other. Theſe, as the Air comes nearer to the Equator, will become ſtronger, and more and more Eaſterly, and be due Eaſt at the Equator itſelf, according to Experience, by reaſon of the Concourſe of both Currents from the N and S where it's Velocity will be at the rate of 2083 Miles in the Space of one Revolution of the Earth or Natural Day, and above 1 Mile and ½ in a Minute of Time; which, is greater than the Velocity of the Wind is ſuppoſed to be in the greateſt Storm, which, according to Dr *Derham*'s Obſervations, is not above 1 Mile in a Minute. But it is to be conſidered, that before the Air from the Tropicks can arrive at the Equator, it muſt have gained ſome Motion Eaſtward from the Surface of the Earth or Sea, whereby it's relative Motion will be diminiſhed, and in ſeveral ſucceſſive Circulations, may be ſuppoſed to be reduced to the Strength it is found to be of.

Thus I think the N E Winds on this Side of the Equator, and the S E on the other Side, are fully accounted for. The ſame Principle as neceſſarily extends to the Production of the Weſt Trade-winds without the Tropicks; the Air rarefied by the Heat of the Sun about the Equatorial Parts, being removed to make room for the Air from the cooler Parts, muſt riſe upwards from the Earth, and as it is a Fluid, will then ſpread itſelf abroad over the other Air, and ſo it's Motion in the upper Regions muſt be to the N and S from the Equator. Being got up at a Diſtance from the Surface of the Earth, it will ſoon loſe great Part of it's Heat, and thereby acquire Denſity and Gravity ſufficient to make it approach it's Surface again, which may be ſuppoſed to be by that Time 'tis arrived at thoſe Parts beyond the Tropicks where the weſterly Winds are found. Being ſuppoſed at firſt to have the Velocity of the Surface of the Earth at the Equator, it will have a greater Velocity than the Parts it now arrives at; and thereby become a weſterly Wind, with Strength proportionable to the Difference of Velocity, which in ſeveral Revolutions will be reduced to a certain Degree, as is ſaid before, of the Eaſterly Winds, at the Equator: And thus the Air will continue to circulate, and gain and loſe Velocity by Turns from the Surface of the Earth or Sea, as it approaches to, or recedes from, the Equator. I do not think it neceſſary to apply theſe Principles to ſolve the Phænomena of the Variations of theſe Winds at different Times of the Year, and different Parts of the Earth; and to do it would draw this Paper into greater Length than I propoſe. From what has been ſaid it follows:

Firſt,

First, That without the Assistance of the diurnal Motion of the Earth, Navigation, especially Easterly and Westerly, would be very tedious, and to make the whole Circuit of the Earth perhaps impracticable.

Secondly, That the N E and S E Winds within the Tropicks must be compensated by as much N W and S W in other Parts, and generally all Winds from any one Quarter must be compensated by a contrary Wind some where or other; otherwise some Change must be produced in the Motion of the Earth round it's Axis.

Observations on falling Dew, made at Middleburg *in* Zeeland *on a leaden Platform, in the Night between* July 25 *and* 26. 1741. *N. S. with Figures of the flakes of Snow observed* Jan. 1742. *By* Leonard Stocks, *M.D.* No. 464. p. 112. *Read* May 20. 1742.

XXIII. *July* 25. at Noon, the Height of the Barometer was 29 *Rhynland* Inches and 2 ¼ Lines. The Height of *Fahrenheit*'s Thermometer was 70 Degrees. The Sky was clear, and the Wind blew gently from the westward. But at the Time of the Observations, from 10 to the first Hour of the Night, the Height of the Barometer was 29 Inches 2 Lines, of the Barometer about 60 Degrees, there being hardly any Wind stirring, and the Sky also being clear.

There fell much Dew upon Glass of various Kinds, so that it was wet all over.

On polished Brass but little and only a thin Vapour.

On rough unpolished Brass a little more.

On Iron tinned (in *Dutch Blick*) a little: On the same of a blue Colour, much: On the same rough very much: On the same smooth hardly any: On the same rusty, none.

On pure Quicksilver none.

On smooth Tin none.

On rough Lead much: On polished Lead a little.

On white Silver none: On polished Silver none: On Silver gilded none.

On blue Porcelaine none.

On a stone Slab much.

On a Basket made of Indian Cane finely woven, a little.

On a smooth Plank of Oak, of a white Colour, very much: On the same of a black Colour, much less.

A smooth Plank of Firr was only just moist.

A smooth Plank of white Deal had very little Dew.

On moving those Bodies, which received much Dew, a little higher, 2 or 3 Inches above the leaden Platform, the Lead dried, and the Bodies themselves were wet underneath as well as above; but the Tin and Silver, being placed in like manner, continued dry, tho' the Place, which was bedewed before, dried up.

Fig. 23. *Jan.* 2. 1742. *N. S.* There fell Flakes of Snow early in the Morning partly formed like Fig. 23. Their Diameters from the extremities of their Points were ¼ of a Line.

Fig. 24. *Jan.* 10. before Noon Fig. 24. ¼ of a Line in Diameter, in the middle of which was a hexagonal Rose, as in Fig. 23. The oval Figures were empty.

Jan.

Jan. 20. About Noon Fig. 25. 1 Line in Diameter, and Fig. 26. 1 ¼ Line in Diameter. The laſt ſhone like *Muſcovy* Glaſs. Fig. 25. Fig. 26.

XXIV. 1. Ice that begins to melt, and Water that begins to freeze, have always the ſame Degree of Cold. *New Experiments upon Ice; taken from* Abbé Nolet, *F. R. S. at* Paris, *and communicated by* J. T. Deſaguliers, *F.R.S.* No. 449. p. 307. Aug. *&c.* 1738.

2. That Cold may be increaſed by a Mixture of Salts.

3. It has been thought for a long time, that *Salt-petre* was moſt fit to increaſe the Cold of *Ice*; but Experiments have ſhewn, that few Salts increaſe Cold ſo little as that Salt. Mix one Part of fine *Salt-petre* with two Parts of beaten *Ice*, and M. *Reaumur*'s Thermometer will deſcend in it but 3 ½ Degrees below the freezing Point.

What had cauſed this Miſtake, is, that People generally made uſe of *Salt-petre* of the firſt or ſecond melting, as being the cheapeſt; but that *Salt-petre* not being purified, contains a great deal of *Sea-Salt*; and it was in Proportion to the Quantity of the *Sea-Salt* that the Effect was the greater.

From this laſt Obſervation, one may deduce an advantageous Method for trying *Gunpowder*; for as of the three Ingredients of which it is made up, *Salt-petre* is the only one that can increaſe the Cold of *Ice*; if one Part of *Gunpowder*, or a little more, be mixed with two Parts of *Ice*, and it increaſes it's Cold more than 3 ½ Degrees, it is a Sign that the *Salt-petre* contained in it is not well purified; and the beſt Powder will be that which does leaſt increaſe the Cold of *Ice*.

4. *Sea-Salt*, that is the *Bay-Salt*, which is commonly uſed at Table in *France*, and that which is immediately taken from the Mines, called *Sal gemmæ*, give the greateſt Degree of Cold, for the moſt part; for *Pot-aſh* gives ſometimes a little more, but generally leſs. *Sea-Salt* mixed with *Ice* in the aboveſaid Proportion, gives 15 Degrees of Cold on M. *Reaumur*'s Thermometer, and *Sal-gem.* 17.

	Degrees.
5. *Aſhes* of *green Wood*	3
6. of *Sea-Coal*	
7. of *Vitriol*	2
8. *Tartar*	10
9. Common *Pot-aſh* (in *French* called *Soude ordinaire*)	3
10. *Pot-aſh* made of *Vreck* or *Sea-weed*	11

This laſt *Pot-aſh* may be ſubſtituted inſtead of *Sea-Salt*, for making *Ice-Creams*, in Places where *Salt* is dear, as in *France*, where it is ſold for 10 Sols a Pound.

1*ſt*, Becauſe in *France* this *Pot-aſh* is ſold only for 2 ½ Sols a Pound.

2*dly*, Becauſe, not freezing ſo faſt, it does not ſpoil the Creams by reducing them to Icicles.

3*dly*, Becauſe *Ice-Creams* made this way, will keep longer in a Condition fit to ſerve at Table.

	Degrees.
11. *Sugar*	4
12. *Allom*	1 ½

13. *Salt*

	Degrees.
13. *Salt* of *Glaſs*	10
14. *Sal Ammoniac*	12 ⅔
15. *Quick-Lime*	1 ¼
16. *Sal Glauberi*	2

17. The Cold of *Ice* may ſtill be conſiderably increaſed by a Mixture of *Spirit of Wine*; about a Drinking-glaſs full of *Spirit of Wine* to a Pound of beaten *Ice*.

18. The Cold of *Ice* will not increaſe, unleſs the *Ice* melts.

Experiments. Put into one Veſſel ℥iv of *Ice* beaten very ſmall, and into another Veſſel ℥ij of *Sea-Salt*; ſet the two Veſſels in a Mixture of *Ice* and *Salt*, which is to be renewed ſtill, till by Means of the Thermometer you find, that the *Salt* and the *Ice* of the two firſt Veſſels have acquired each of them 10 or 12 Degrees of Cold; then mix your *Salt* with your *Ice*, and this Mixture will not increaſe the Degree of Cold that the Ingredients had acquired, becauſe the Mixture does not melt.

But if inſtead of *Salt* you mixed with your *Ice Spirit of Nitre*, cooled to the ſame Degree as the *Ice*, as this laſt is liquid, it will melt the *Ice*, and conſiderably increaſe it's Cold.

19. Salt mixed with Water, increaſes it's Cold.

20. Of all Salts, *Sal Ammoniac* gives the greateſt Degree of Cold; ſo that if that Salt has been cooled in *Ice*, and then one Part of it be thrown into two Parts of Water cooled to the ſame Degree in *Ice*, that Water will become colder than *Ice*, and will freeze other Water thrown into it in a ſmall Quantity.

This laſt Obſervation may be applied to the cooling of Liquors where no *Ice* is to be had; for there is hardly any Place but what has Wells: Now the Water of a Well moderately deep, wants about 8 or 10 Degrees of the Cold of *Ice*; and *Sal Ammoniac* being cooled beforehand in the Well, will, by mixing with ſome of the Water of that Well, come very near to the Cold of *Ice*.

An Account of an extraordinary Effect of Lightning in communicating Magnetiſm. By Dr Cookſon *of* Wakefield *in* Yorkſhire. No. 437. p. 74. Apr. *&c.* 1735.

XXV. 1. A Tradeſman in this Place having put up a great Number of Knives and Forks in a large Box, ſome in Caſes or Sheaths, and others not, of different Sizes, and of different Perſons making, in order to be ſent beyond Sea; and having placed the Box in the Corner of a large Room, there happened a ſudden Storm of Thunder, Lightning, *&c.* by which the Corner of the Room was damaged, the Box ſplit, and a good many Knives and Forks melted, the Sheaths being untouched. The Owner emptying the Box upon a Counter where ſome Nails lay, the Perſons who took up the Knives that lay upon the Nails, obſerved that the Knives took up the Nails. Upon this the whole Number was tried, and found to do the ſame, nay, to ſuch a Degree as to take up large Nails, Packing-Needles, and other Iron Things of conſiderable Weight. Needles or other Things placed upon a Pewter-Diſh, would follow the Knife or Fork, though held under the Diſh, and would move along as the Knife or Fork was moved; with ſeveral other

odd

odd Appearances, which I won't now trouble you with, only this, that though you heat the Knives red-hot, yet their Power is ſtill the ſame when cold.

You may be aſſured of the Truth of this, having myſelf made a good many Trials of the Knives and the Forks: How they came by this magnetick Power, or how Lightning ſhould be capable of communicating ſuch a Power, is the *Query*.

Decem. 6, 1732.

A further Account of the extraordinary Effects of the ſame Lightning at Wakefield. *By the ſame.* Ibid. p. 75.

2. This Storm of Thunder and Lightning happened the latter End of *July*, 1731, and not only broke the Glaſs and Iron Frames of the Croſs-Chamber Windows, but at the ſame Time ſplit ſome Studds in the Corner of a Wood-Houſe; and paſſing into a Room, ſplit likewiſe a large Deal Box, which ſtood in the S. Corner of the Room, where the Lightning entered, and diſperſed a great many Dozen of Knives and Forks, which were put up in the Box, all over the Room.

Upon gathering up theſe Knives and Forks, ſome of them were melted, others ſnapped in ſunder; others had their Hafts burnt; others their Sheaths either ſinged or burnt; others not: But what was moſt remarkable, upon laying them on a Counter where there were Iron Nails, Rings, *&c.* it was obſerved, that when any of them were taken up, there hung a Nail or Ring at the End of each of them: Moſt of them were tried, and found to do the ſame; but little further Notice being taken of them at that Time, they were thrown aſide as damaged Goods.

Some Diſcourſe concerning the Effects of Thunder and Lightning happening to be the Subject of Converſation in a Company, where the Owner of theſe Knives was not long ago, he told them what had happened at his Houſe, and particularly to the Knives and Forks; and being aſked whether he had any of them left, ſaid that he had; and upon Trial, it was found that a good many of them were poſſeſſed of this magnetick Virtue.

Hearing of this, I went and found what was related, and what I ſent you an Account of before, to be Fact, and have now ſent you a couple of Knives and Forks, one for yourſelf, another for the *Royal Society*.

The Whittle-Knife, with the Box-Handle, is that which I would have you preſent to the Society; it is an excellent one, and one of the beſt: I had Thought to have kept it myſelf; but if it will be acceptable to that famous Body, it will be much more agreeable to me. They will perceive that it has been uſed pretty much; and the Owner's Son, who gave it to me, told me, that he has made uſe of it for almoſt a Year and an half to all Manner of Purpoſes; notwithſtanding which it ſtill retains the magnetick Virtue to an extraordinary Degree.

The Situation of the Room, Poſition of the Box and Knives, and Direction of the Lightning, may poſſibly contribute to a fuller Idea of

the Matter: I ſhall therefore preſume to give a Plan of them, an Horizontal one, and ſubmit it and the following *Queries* to the Conſidera- of that learned Body.

Fig. 27.

A. The South Angle of the Room where the Lightning entered.
B. The Direction of the Lightning.
C. The polar or magnetick Line.
D. The Box with the Knives lying in a Direction parallel to the longer Sides of the Box.

Query, Whether the Knives and Forks lying in ſuch a Direction as either to coincide, or make but an acute Angle with the magnetick Line, might any Ways contribute to their imbibing this magnetick Virtue; ſince a Bar of Iron placed in ſuch a Direction, ſhall in a ſmall Time receive a tranſient Polarity, and if it continue a long Time in that Poſition, a fixed and permanent one?

Query, Whether the Knives and Forks lying in ſuch a Poſition, and being violently heated by the Lightning, might not, as they cooled, ſtrongly imbibe this magnetick Virtue; ſince a Bar of Iron heated and placed in a certain Direction to cool, will ſooner imbibe this Power than in the ſame Direction cold?

Query, The Polarity of the Compaſs has been altered by Lightning, as it is to be ſeen in the *Philoſophical Tranſactions*: Now how ſhould Lightning be capable of communicating ſuch a Power in this Caſe, ſince it is plain that it has taken it away in another?

Concerning a File rendered magnetical by Lightning. By M. de Bremond, M. D. Tranſlated from the French by T. S. M. D. F. R. S. No. 459. p. 614. Jan. &c. 1741.

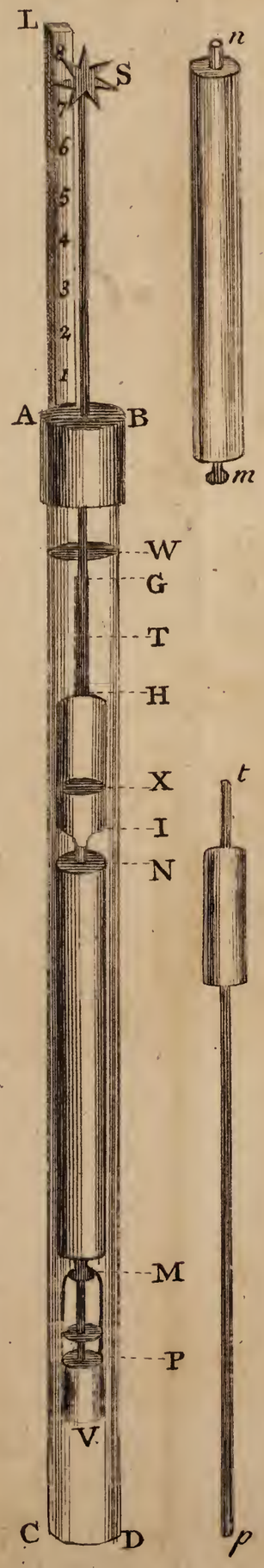
3. I have received a Letter from the Coaſt of *St André* in *Dauphiné*, dated *Sept.* 7, 1739, giving an Account of a Fact of the ſame Nature, with the preceding, which I here ſend you as I received it.

" Three Weeks ago the Lightning fell 30 Paces from my Houſe on " that of a Clock-maker. I ſhall not enter into the Particulars of the " Ravage it committed. Every Body knows how ſurpriſing the Effects " of Thunder are: But here is one that is very ſingular. The Thun- " der broke one of the Clock-maker's Files, 4 Inches from the End; " ſo that there ſtill remained 7 Inches of it in the Handle; and the Piece " of 4 Inches long, that was broken off, remained on the Shop-board.

" The next Day after the Accident, the Clock-maker, obſerving that " the remaining Part of this File might ſtill be of Service to him, " took it up, and worked with it. But he was much ſurpriſed to ſee, " that Iron followed the End of his broken File. He applied this " End to a Punch, (or Drill) and the Punch was immediately attracted " to the File. He called to me, and I made ſeveral Trials of this at- " tractive Quality. I took the Piece of the File that had been broken " off, and applied it to an Iron Ring for hanging Keys; which it

" lifted

Fig. 20.



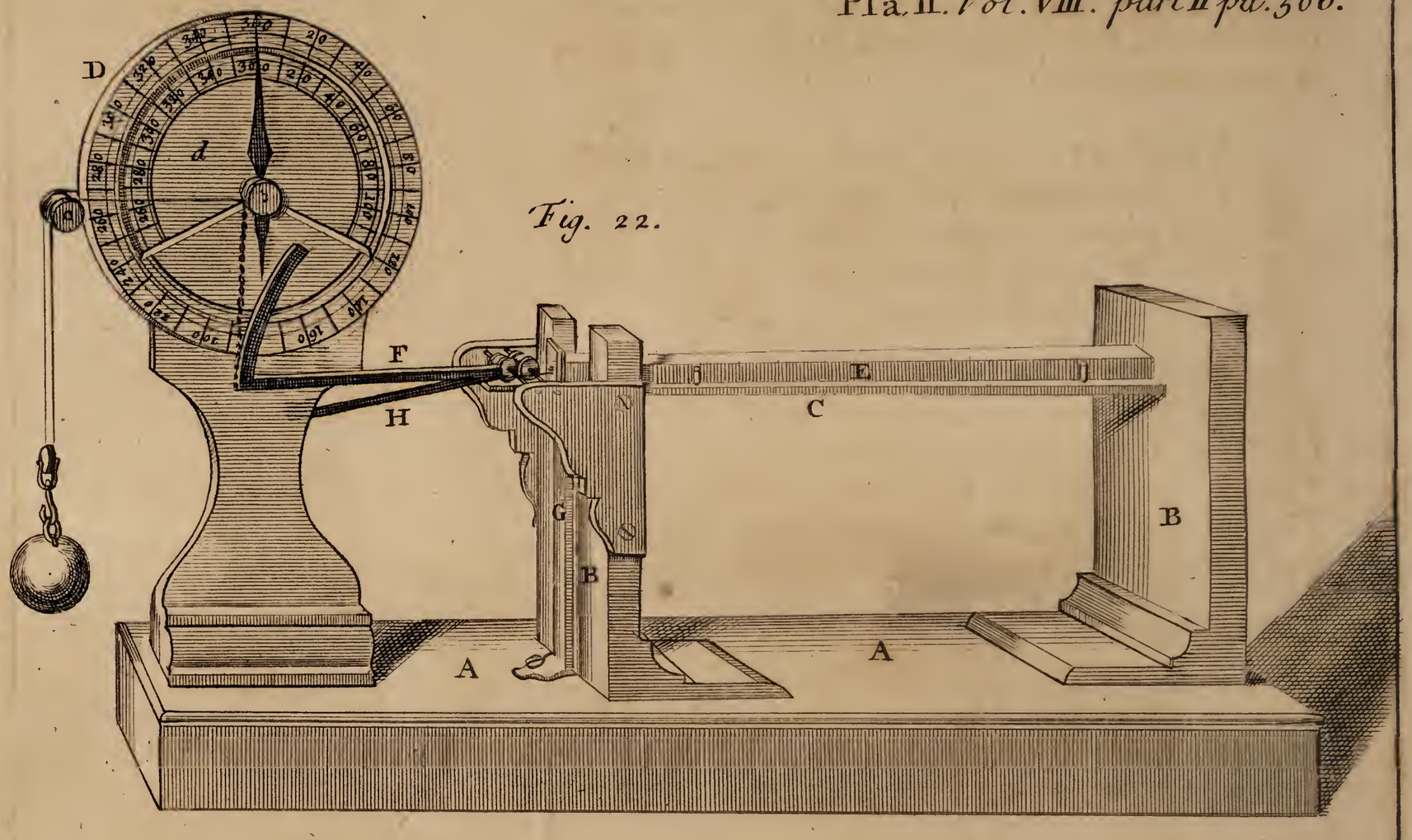


Fig. 22.

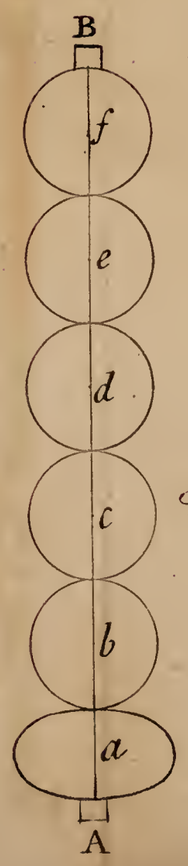


Fig. 21.

Fig. 23.

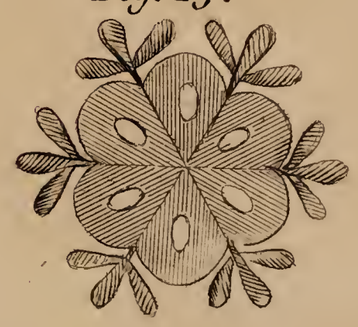


Fig. 24.

Fig. 25.

Fig. 26.

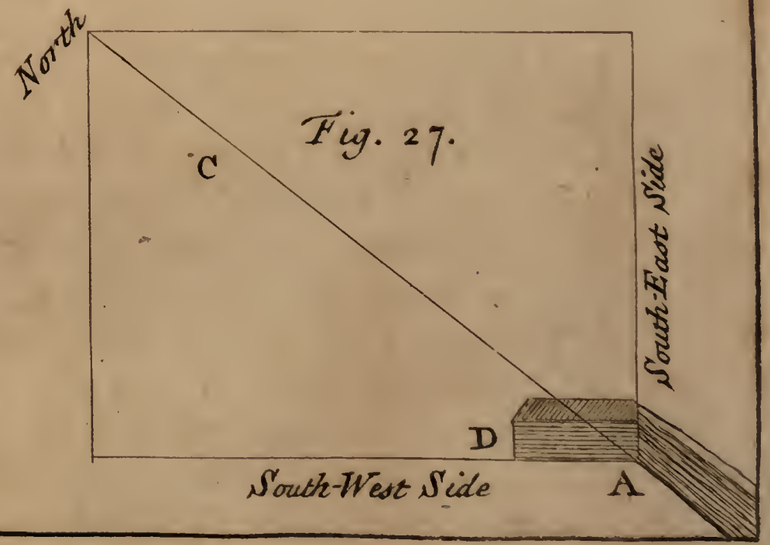


Fig. 27.

" lifted up perfectly well, and held ſuſpended as long as I thought
" proper. I doubted not but it was the Lightning that had communi-
" cated a magnetick Quality to this File; and I found, upon Trial,
" that this Quality was given only to the Inſide of the File, and the
" broken Piece; for I applied Bits of Iron to every Side of it, with-
" out any Effect, the Virtue reſiding no-where but in the Place that
" was broken. I broke in two the ſame Piece of 4 Inches; and one
" of the two Pieces attracted Iron at both Ends, the other only at it's
" broken End. I rubbed the Point of my Knife on one of theſe two
" Bits of the File, and it communicated to my Knife a Degree of
" Magnetiſm ſufficient to raiſe Needles, and hold them ſuſpended."

Concerning the crooked and angular Appearance of the Streaks or Darts of Lightning in Thunder-Storms. By James Logan, *Eſq; Dated* Philadelphia, Sept. 20, 1735. No. 441. p. 240.

XXVI. Looking into the ſecond Volume of that ingenious Gentleman *Stephen Hales*'s Staticks, of which I have lately happened to have a curſory View, I obſerved him to mention that Phænomenon of the Streaks or Darts of Lightning in Thunder-Storms appearing crooked and angular, (I do not remember his Words) as a Thing not yet accounted for; and therefore he gueſſed at a Solution of it *.

The Clouds are generally diſtinct Collections of Vapours like Fleeces, and therefore the Rays of Light through them muſt paſs through very different Denſities, and accordingly ſuffer very great Refractions: From thence therefore, undoubtedly, that Appearance muſt ariſe: For it is moſt highly abſurd to imagine, that Fire, darted with ſuch a Rapidity, can from any aſſignable Cauſe deviate in Fact from a right Line, in the Manner it appears to us. And this, if duely conſidered, may probably be found a plenary Solution.

Extraordinary Effects of Lightning, by Sir John Clark, *one of the Barons of the Exchequer in* Scotland, *and F. R. S. Dated* Nov. 6. 1731. No. 454. p. 235.

XXVII. I was lately in *Cumberland*, where I obſerved in *Whinfield-Park*, belonging to the Earl of *Thanet*, a huge Oak, at leaſt 60 Foot high, and four in Diameter, upon which the laſt great Thunder had made a very odd Impreſſion; for a Piece was cut out of the Tree about 3 Inches broad, and 2 Inches thick, in a ſtrait Line from Top to Bottom. In another Tree of the ſame Heighth, the Thunder had cut out a Piece of the ſame Breadth and Thickneſs, from Top to Bottom, in a ſpiral Line, making 3 Turns about the Tree, and entering into the Ground above 6 Foot deep.

Concerning ſome extraordinary Effects of Lightning, by the Right Hon. Robert James *Lord* Petre, *F. R. S.* No. 464. p. 136. *Dated* June 24, 1742.

XXVIII. On *Tueſday* Morning, between 3 and 4, we had at *Thorndon* ſome of the moſt terrible Thunder I ever heard; and, indeed, by the Effects of it, I have Reaſon to conclude, that it was very near us, as well as by the Noiſe, to which I really think no other Thunder I ever yet had any Notion of, could be compared. It has beat down a Chimney at a Farm-houſe juſt by, and the Lightning has alſo ſtruck two large Oaks in my Park, which ſtand about 40 or 50 Feet apart. In one of them I do not obſerve any thing much different from other Trees which I have before ſeen ſtruck with Lightning; the only Thing that ſeems remarkable, is, that the greateſt Damage appears to be done

* See *Steph. Hales*'s Statical Eſſays, Vol. 2, p. 291.

to the Eaſt Side of the Tree, although it is certain, that the Storm all came from the S W. This Tree is extremely ſhattered, and ſplit from the Top to the Bottom; and on the S W Side, juſt by the Root, there is a large Hole made in the Ground, about 6 or 7 Inches Diameter, and about a Foot or 15 Inches deep. But in the other Tree, I think, there is ſomething more particular; for there, without ſhattering or ſplitting the Tree in the leaſt, or ſo much as diſturbing a ſingle Branch, although there are a great many upon it, the Lightning has taken off the Bark about 5 Inches wide, in a complete ſpiral Line, from about 40 Feet high, down to within about a Foot of the Ground, where the Width diminiſhes to about 2 Inches, and ſo goes quite off: In the Centre of theſe 5 Inches, it has entered the Wood about $\frac{3}{4}$ of an Inch deep, and about 1 and $\frac{1}{2}$ Inch wide: This Hollow it has in great Part cleared out entirely, and the reſt is left hanging like Pieces of broken or untwiſted Ropes; this Hollow alſo diminiſhes near the Ground, and dies quite out exactly at the Ground: The ſpiral Line is exactly regular, and goes juſt once round the Tree, or but very little more, and, as near as I can obſerve, is exactly of an equal Width all the Way. The Surface of the Bark of both the Trees is remarkably touched for about 10 Feet from the Ground, as if it were ſhot all over with ſmall Shot, each of which ſeems to have taken off little Scales or outſide Pieces of the Bark, from 1 $\frac{1}{2}$ Inch or 2 Inches broad and long, to $\frac{1}{4}$ of an Inch.

A Halo obſerved at Rome, Aug. 11, 1732, *by the Abbot* Didacus de Revillas. No. 438. p. 118. July, &c. 1735.

XXIX. A ſimple Halo, terminated on all Sides, and exactly circular encompaſſed the Sun from 9 in the Morning till 2 in the Afternoon. The Breadth of the Zone ſeemed to equal the apparent Diameter of the Sun. The inmoſt Colour was red, the others paler, and analogous to thoſe of the Rainbow, but ending in white, and ſomewhat altered about Noon. The Sky was a little hazy, and there was a gently N Wind. The Miſt thickened afterwards into whitiſh Clouds, whilſt the Halo diſappeared, the Diameter of which, from the inner Edge of the Zone, was 45°.

Height of the Barometer	*Paris* Inches.
Eight in the Morning	27 11
Noon	27 10 $\frac{1}{2}$
Two in the Afternoon	27 10 $\frac{1}{2}$

Obſervations of two Parhelia, or Mock-Suns, ſeen Dec. 30, 1735, *by the Rev. Mr* Timothy Neve, *Secretary of the Gentlemen's Society at* Peterbo-

XXX. On *Tueſday, Dec.* 30, 1735, as I was riding betwixt *Cherry Orton* and *Alwalton* in the County of *Huntingdon*, I obſerved two *Parhelia*, the firſt of which ſhone ſo bright, that at firſt Sight I took it for the real Sun, till looking a little farther on my Left-hand, I was convinced of my Miſtake, by ſeeing the true Sun much the brighteſt in the Middle, and a *Mock-Sun* on each Side, in a Line exactly parallel to the Horizon. I gueſſed their Diſtance to be about 40 Diameters of the Sun, or, as they uſually appear, 23 Degrees. That on the Left-hand of the Sun, when I ſaw it firſt, was ſmall and faint, but in about 2'

Time

Time became as large and bright as the other, and appeared at once as two white lucid Spots on each Side the Sun, East and West, seemingly as big, but not so well defined: In about 3′ they lost both their Colour and Form, and put on those of the Rainbow; the Red and Yellow in both very beautiful and strong nearest to the Sun, the other Colours fainter. They became as two Parts of an Arch, or Segment of a Circle, with the Concave towards the Sun, only round at Top, the Light and Colours streaming downwards and tending towards a Point below. This continued for about 4 or 5′, when the Colours gradually disappearing, they became, as before, two lucid Spots, without any Distinction of Colours. They lasted a full Hour, sometimes one brighter, and sometimes the other, according to the Variation of the Clouds and Air, as I suppose. When I first saw it, it was exactly a Quarter after 11. There had been a Frost in the Morning, which went away pretty soon with a thick Mist, and between 10 and 11 cleared up, leaving only a Haziness in the Air behind it: The Weather quite calm, Wind, as I thought, N W.

rough. No. 445. p. 52. Jan. &c. 1737.

These *Parhelia* commonly are seen with a Circle or Halo round the Sun, concentrical to it, and passing through the Disks of the spurious or *Mock-Suns*. But there was not the least appearance of such a Circle here, it having only a Tendency towards one, when it was seen with the Rainbow Colours.

XXXI. This Day, a little after 10 in the Morning, a Friend told me, that several Suns were to be seen in the Heavens: Whereupon I went directly into the Garden adjoining to my House, and immediately saw near the Sun S, on it's Left or Western Side (1) the *Parhelion* B, as big as the true Sun. This *Mock-Sun* (2) was amidst little, round, white Clouds, set thick, and close to one another. (3) The Part of the *Parhelion* which faced the West was not round, but broken, having about a third Part of it's Circumference open, and shooting out the long bright Stream or Tail BH. (4) To this, both above and below, adhered another Stream F G (5) somewhat curved, (6) with it's Horns turned from the Sun Westward. (7) The Middle of this *Mock-Sun* shone with so great a Light, that the naked Eye could not bear it; wherefore I viewed it attentively through a Glass darkened with the Smoak of a Wax-candle. (8) The Light of the *Parhelion* B appeared much weaker than that of the true Sun. (9) It's Circumference which faced the Sun, was red: Likewise (10) that Part of the Stream F G, which was towards the Sun, was purple. Within the red Border appeared the other Colours of the Rainbow, as yellow, green, and azure. And the Stream B H was likewise embellished with red and yellow. Both Edges of this were reddish, and it's Middle yellowish. (11) The Sun S, was 15 ½° above the Horizon; and it's Image B was near the same Altitude, for I then found it to be 14°. (12) I measured the Distance from S to B, more than once, and found it to be 20°. (13) The Arch F G was near 6° in Length. (14) Most of the South part of the Hemisphere was overspread

An Observation of two Parhelia, or Mock-Suns, seen at Wittemberg *in* Saxony, Dec. 31, 1735. *O.S. By* John Frid. Weidler, *F. R. S. &c. Translated from the Latin by* T. S. *M.D. F. R. S. Ibid.* P. 54. Fig. 28.

overſpread with white Clouds, interſperſed here and there with ſome darker ones. There were ſome thin Clouds before the true Sun, through which it's Rays eaſily paſſed. (15) When thicker Clouds ſurrounded the Sun, the Brightneſs of the *Parhelion* was leſſened. (16) The *Parhelion* was now and then hid by dark Clouds. (17) The thin white Clouds, with which the Northern Part of the Sky was overſpread, reached up to the *Zenith*. (18) Soon after my firſt obſerving the *Parhelion* B, as I looked up to the *Zenith*, I ſaw the beautiful Rainbow C D E parallel to the Horizon, with it's Horns turned to the North. It had the uſual Colours of the Rainbow, all very diſtinct. The Purple was on the Side facing the Sun; next to it was the Yellow, then the Green, and laſt the Azure. (19) A Line drawn from the Sun's Centre to the Middle D of the *Iris* tended to the *Zenith*, and was a Portion of that vertical Circle, in which the Sun then was. (20) The Point D was 61° diſtant from the Horizon; wherefore the Diameter of the Rainbow was 58°: (21) However, there was but Part of the Rainbow C D E ſeen, the Ends of which were ſometimes but 38° from one another: For more or leſs of it appeared at different Times, but ſcarcely above ¼ Part of it's Circumference at any Time. (22) It was ſometimes ſeen among ſmall white Clouds, which were about the *Zenith*, and ſometimes in a clear Sky. It laſted till the Sun and moſt part of the Sky was overcaſt by thick Clouds. (23) The Thickneſs of the Rainbow C K, as well as I could eſtimate by the bare Eye, was one Degree of a great Circle.

But as the neighbouring Houſes prevented my having a free Proſpect Eaſtward from my Garden, I went to another Place, whence I had a full View of the Hemiſphere. And having reached thither a little before 11, I immediately ſaw another *Parhelion* A to the Eaſt, (24) 20° from the Sun, as the foregoing was, and raiſed 15° above the Horizon. (25) This *Mock-Sun* was not inferior to the other B, in Brightneſs, for the naked Eye could no more bear it than that. (26) It's Light was white; (27) it's Figure round, and it's Size equal to that of the Sun S. (28) This *Parhelion* A, ſhot out the Stream I L, which was rectilinear, white and reſplendent, 8° long, and, as far as I could poſſibly diſcover, void of Colours; (29) for it appeared among ſmall white broken Clouds, and laſted ſomewhat longer than the former, without changing it's Figure. (30) Upon the Sun's being hid by thick Clouds about half an Hour after 11, both theſe *Mock-Suns* diſappeared, but became viſible again, upon the Sun's ſhining bright.

The Whole of the *Phænomena* obſerved in theſe *Parhelia* comes to this: That the true Sun, S, was accompanied by two *Parhelia*, both 20° diſtant from the Sun, one on each Side, and having nearly the ſame Altitude with the Sun from the *Horizon*. Above the *Parhelia*, Part of a Rainbow ſurrounded the *Zenith*; and each of the *Parhelia* ſent forth a bright luminous Stream or Tail, one rectilinear and white, the other ſomewhat curved and coloured. Moreover, from the weſtern *Parhelion*, a Stream parallel to the *Horizon*, and ſomewhat pointed, extended itſelf

on

on the Side oppoſite to the Sun; and this Scene laſted the two Hours of 10 and 11 before Noon, until thick Clouds put an end to it. There was no Appearance of an entire Crown, ſuch as uſually accompanies *Parhelia*, and encircles the Sun; although I obſerved the Track of the Sky near the Sun, both with the naked Eye and through Glaſſes.

As to the State of the Heavens on the 11th of *January*, when the *Parhelia* were obſerved; early in the Morning a thick Fog overſpread the *Horizon*; about nine this Fog condenſed into ſmall Drops of Rain, which fell ſlowly: Soon after, the Vapours were collected into thin Clouds, particularly in that Part about the Sun. Then the Sky became clear about the North, and there blew a gentle Wind a little to the South of the Eaſt.

After Noon, Clouds gathered to the Weſt; about 30 Minutes after 12, the whole Hemiſphere was overcaſt, but in the Evening it became clear and ſerene on all Sides. On the following Days, from the 12th to the 17th of *January*, N. S. the Sky was conſtantly cloudy or dark, and the Sun ſeldom ſeen thro' the breaks of the Clouds. On the 18th Day, the Weather cleared up, which laſted three Days. On the 21ſt, that I am writing theſe Obſervations, the whole Surface of our Hemiſphere is overcaſt with Clouds; and therefore this Appearance of *Parhelia* has not been attended with any uncommon Weather.

N. B. The Publiſher having ſent Mr Profeſſor *Weidler* an Account of Mr *Neve's* Obſervation of the *Mock Suns*, ſeen by him in *England*, which ſeem to agree in ſo many Circumſtances with thoſe ſeen by the other in *Germany*: The Profeſſor ſaith in his Anſwer, "That it ſeems to him very worthy of Remark, that *Parhelia*, ſo "very much alike, ſhould appear two ſubſequent Days in Places ſo diſtant from each "other; which indicates a ſimilar State of the Air or Atmoſphere in both." This extraordinary Incident put the Profeſſor upon writing an Eſſay on the Cauſe of *Parhelia*, and accordingly he hath publiſhed a ſmall Pamphlet in Quarto, intituled, *Jo. Friderici Weidleri* Commentatio de *Parheliis* menſe *Januarii* Anno M.DCC.XXXVI. prope *Petroburgum Angliæ*, & *Vitemburgæ Saxonum* viſis. Accedit de *Rubore Cæli* igneo menſe *Decembri* Anno 1737. obſervato *Corollarium*. *Vitembergiæ*, 1738. in 4to. *See* §. 33. *of this* Chap.

XXXII. As I was reading this Morning a little after 7, in a Room looking towards the N E, I accidentally took Notice of an odd Stream of coloured Light, ſhooting upwards from the Sun, as I then thought, ſhining through a thin wateriſh Cloud; but recollecting the Appearance was ſeveral Degrees more northerly than the Sun's true Place at that Time, I immediately went to the Window, and found what I had taken for the Sun was a *Parhelion* ſhooting out a ſhort horizontal Stream or Tail towards the North; the Sun itſelf ſhining pretty bright and clear at the ſame Time. I alſo obſerved, the Stream I had at firſt ſeen, was part of an Arch concentric to the Sun, and paſſing through the *Parhelion*: This Arch was for a good Way tolerably defined, and tinged with Red on the Inſide, and a blueiſh White on the other. I then caſt my Eye to the other Side the Sun, where I perceived a ſecond *Parhelion*, at the ſame Diſtance from him, towards the South, tho' not yet ſo bright as the firſt

An Obſervation of three Mock-Suns ſeen in London, Sept. 17. 1736. by Martin Folks, Eſq; V. Pr. R. S. Ibid. p. 59. Fig. 29.

firſt. I then went up to my Leads, my Proſpect being too confined below: Where ſoon after I was come, I found the *Phænomenon* conſiderably to improve, the Arch round the Sun forming itſelf into more than a Semicircle, reaching almoſt to the *Horizon* Northward, and with very little Diſcontinuance beyond the ſecond *Parhelion* towards the South. I then began to perceive a third *Parhelion* where the Circle ſurrounding the Sun would have been cut by the Vertical paſſing through him; and in the ſame Place his Circle was touched by the Arch of another, in ſome ſort confounding itſelf with it in the Place where the third *Parhelion* appeared: This was fainter a good deal than the other two, and the laſt Arch I have been ſpeaking of extended but a little way, ſo as for it to be difficult to determine where it's Centre lay; this Arch was coloured alſo, but with Red on it's convex Part. I had ſome Time before this began to ſee alſo another Circle, ſurrounding the Sun at the Diſtance of about 45°, which appeared to be about twice the Diſtance of the firſt; and this alſo increaſing whilſt I was conſidering it, became little leſs than a Semicircle, being alſo tinged with Red like the other on the inner Side. When this Circle had thus pretty well formed itſelf, I alſo diſcovered the Arch of a fourth, touching this, or rather confounding itſelf with it, in it's higheſt Part, and ſurrounding, as it ſeemed, the *Zenith*. Of this laſt Circle I ſaw, when it was moſt complete, better than half, and it was much ſtronger coloured than any of the others, being of a bright Red on it's convex Part, and a good Blue on the Concave. In the Part where this Circle confounded itſelf with the larger of thoſe that were concentric to the Sun, their common Part was nearly white, and brighter than the reſt, though hardly enough to call it a fourth *Parhelion*. The principal *Mock-Suns* continued tolerably bright till near 8, the ſouthern Part of the *Phænomenon* improving as the northern decayed; and the ſouthern *Parhelion* was once ſo bright, that, taking the Advantage of a place where a Chimney ſhaded the true Sun, it caſt a very viſible Shadow: The white and luminous horizontal Tail alſo, that went from this *Parhelion*, was much longer than that of the other, reaching at one time beyond the outer of the 2 concentric Circles. The *Parhelia* themſelves, tho' very luminous, were however never defined with any Exactneſs as to their Diſes, but looked as we ſometimes ſee the Sun through a thin whitiſh Cloud, and they were themſelves of a reddiſh Colour on that Side next the true Sun. About 8 the *Phænomenon* was ſenſibly decreaſed, and had entirely diſappeared by 20′ after.

An Account of a Tract intituled, Jo. Friderici Weidleri Commentatio de Parheliis Menſe Januario Anni

XXXIII. This Tract is divided into 17 Sections. In the *1ſt* and *2d* the Author deſcribes his own Obſervation of two *Mock-Suns* at *Wittemberg*, on *Jan.* 11. 1735-6, *N. S.* In the *3d* he gives a Meteorological Diary from *Jan.* 1. to 18. and in the *4th* the Rev. Mr *Neve*'s Obſervation on $\frac{Dec.\ 31.}{Jan.\ 11.}$ of two *Parhelia* near *Peterborough*. But theſe Deſcriptions have been already communicated to the *Royal Society**. In the *5th*

* See §. xxx, and xxxi. of this Chap.

he

he compares the two Obſervations. In the *6th* and *7th*, he mentions ſeveral *Parhelii* taken notice of by the Ancients and Moderns; and in the *8th* enumerates the different Obſervables of this *Phænomenon*, for the better inveſtigating it's Cauſes.

The *9th* gives the Opinions of ſeveral of the Ancients concerning the Preſages taken from Mock-Suns.

From the *10th* to the *13th* incluſive, he relates divers Manners of accounting for them, by the chief of the Ancients and Moderns.

In the *14th*, preparatory to his own Opinion, he lays down the Doctrine of the Riſe of Vapours in ſmall globular Bubbles of Air, with a watery Coat to each,

In the *15th*, he refutes, by ſeveral Reaſons and Experiments, *Huygens*'s Manner of accounting for *Haloes*, which is by a vaſt Number of very ſmall Vapours, each with a ſnowy *Nucleus*, coated round with a tranſparent Covering: And ſays, that when the Sun depicts it's Image in the Atmoſphere, and by the Force of it's Rays puts the Vapours in Motion, and drives them towards the Surface, till they are collected in ſuch a Quantity, and at ſuch a Diſtance from the Sun on each Side, that it's Rays are twice refracted, and twice reflected, by the time they reach the Eye; they exhibit the appearance of a *Halo*, adorned with the Colours of the Rainbow: Which may happen in globular pellucid Vapours without ſnowy *Nuclei*, as appears by the Experiment of hollow glaſs Spheres filled with Water. Therefore, whenever thoſe ſpherical Vapours are ſituated, as before, the Refractions and Reflexions will happen every where alike, and the Figure of a circular Crown, with the uſual Order of Colours, will be the Conſequence.

As to the *Halo*, that attends *Parhelia*, being 44 or 45° in Diameter, he adopts *Gaſſendi*'s Opinion as probable, who applies to it the Geometrical Theorem: *De Angulo ad Centrum, duplo Anguli ad Peripheriam.* For when a *Halo* ſurrounds the Sun, the Sun is in the Centre, and the Eye out of it, as it were on the Surface of the *Phænomenon*; whereas, when the Rainbow appears, the Eye is placed in a Line drawn from the Sun to the Centre of the Rainbow: And thus the Eye ſerves for a Centre, from which the Diameter of the *Iris* is beheld, the Sun being placed on the Circumference. Yet he ſays, it ſtill remains to be accounted for, Why, when two *Haloes* appear at once, the Greater is double the Diameter of the Leſs, *i. e.* about 90°?

16th, But as *Haloes* often appear about the Sun and Moon, without *Parhelia* or *Paraſelinæ*, there muſt be a peculiar Diſpoſition of Vapours requiſite for forming *Parhelii*.

Parhelii, he ſays, are ſituated either in the Interſection of a vertical *Halo*, and the horizontal *Annulus*, which paſſes through the Sun; or in the Section of ſome horizontal Bands and the *Corona*: And the angular Figure of *Parhelia* leaves us no room to doubt, that it is produced by Planes of the *Annulus* or Bands running into the *Corona*. Now *Newton*'s Theory of Colours, and the Experiments it is built upon, ſhew, that

1736. prope Petroburgum Angliæ & Vitembergæ Saxonum viſis, Accedit de rubore cœli igneo Menſe Decembri Anni 1737. obſervato Corollarium. Vitembergæ, 1738. 4to. *Drawn up by* Tho. Stack, *M.D. F.R.S.* No. 458. p. 459. Sept. &c. 1740.

Whiteneſs, which is a heterogeneous Light, is reſtored by blending or collecting the couloured Lights: And this will likewiſe happen, when the white heterogeneous Light of the bright Ring or Band does penetrate and confound the Rays of the *Halo*, now ſomewhat weakened. It is plain, that in order to a genuine Explication of Mock-Suns, it is chiefly requiſite to have a clear Notion of the Origin of the horizontal Ring, or Bands. And from *Huygens*'s Experiment with a cylindric Glaſs full of Water expoſed to the Sun, which produces a white horizontal Ring by Reflexion alone, without an opake *Nucleus*; he aſſerts that the horizontal Bands, that interſect the ſolar *Coronæ*, are formed, when cylindric frozen Vapours are ſuſpended about the Sun, chiefly where the *Halo* is depicted, in a Situation perpendicular to the Horizon; which being rectilinear, each of them exhibits by Reflexion a lucid Line equal to the Sun's Diameter; and ſeveral of theſe optic Lines joining, compoſe the Plane of the Ring or Band.

His laſt Section is ſpent in explaining the Appearance of Part of an inverted *Iris*, which accompanied his Mock-Suns: In order to which, he thus accounts for a (common or) primary Rainbow.

A primary *Iris* is formed, when the Sun's Rays falling on Drops of Rain, after ſuffering two Refractions, and one Reflexion, tend to the Eye in ſuch a Direction, that the Axis of the *Iris*, coming directly from it's Centre, and paſſing by the Eye to the Sun, makes with theſe Rays returning from the Drops, an Angle of 40° below, and of 42° above; whereby the Width of the *Iris* is 2° 15′, and it's Diameter 42° 17′.

But as this inverted *Iris* was but one Degree broad, and the Diameter of the Arch probably but half that of the primary *Iris*; he is of Opinion, that the Sun's Rays, refracted and reflected as above, entered the Eye at half the aforeſaid Angle, by the Eye's being placed beyond the Point, where the Rays met with the Axis. For thus the Order of the Colours is preſerved, and this *Iris* is but half the Size of the common one.

See Sect. xlvi. of this Chap.

As an Appendix to this Tract, Profeſſor *Weidler* adds the following Account of the remarkable red Lights on the $\frac{16}{5}$ *December* 1737, ſeen not only by him at *Wittemberg*, but here at *London*, and in moſt Parts of *Europe*.

December 9, 1737, the Barometer was remarkably low; *viz.* 28 Inches 8 Lines *Engliſh* Meaſure. It rained all that Day very plentifully; and from thence to the End of the Month the Sky was much loaded with thick Vapours. But on the 16th, the little Wind there was being at N W, and the Barometer at 30 Inches 2 Lines $\frac{3}{4}$ *London* Meaſure, ſoon after Sun-ſet, (the Moon in it's laſt Quarter) the Sky began to appear very red; and, from Seven to Nine, gave a Light as ſtrong as that of the Full-Moon behind a thin Cloud. The whole Sky was of that Colour, which is occaſioned by a Fire ſeen at a Diſtance in the Night. Such an uncommon Sight put the Inhabitants of this Town in great Terror,

Terror. The greateſt Brightneſs here was about $8^h\ 45'$; from which Time it gradually decreaſed; and at a Quarter after nine it ſeemed almoſt diſſipated. But it returned now and then, and continued, by Intervals, all Night. Now though the whole Face of the Heavens was remarkably red, yet the greateſt Brightneſs was in the N, and a little to the W. There were neither Pyramids, nor luminous Streamings, ſo common in *Auroræ Boreales*; nor even the leaſt Appearance of the horizontal black Cloud at North. The following Day was equally dark with the preceding, yet without the leaſt Remains of the Redneſs. Such was the Face of the Heavens at *Wittemberg*, and in the Neighbourhood. And, ſoon after, the publick News gave an Account of the like *Phænomenon* being ſeen at *Vienna*, *Venice*, *Mantua*, *Florence*, *Rome*, and ſome other Places. At *Vienna* the greateſt Brightneſs was obſerved at $9^h\ 15'$. The moſt enlightened Parts were the N W, and S S E; and there were ſome Returns of the Brightneſs on the 17th and 18th: But in *Italy*, at *Mantua*, *Florence*, and *Rome*, the Redneſs was accompanied with lucid Columns and Pyramids. And from *Rome*, in particular, they write, that this *Aurora Borealis* exceeded in Brightneſs all thoſe that had been hitherto obſerved. From theſe Obſervations it is no difficult Matter to deduce the Cauſes of theſe red Lights.

That this *Aurora Borealis*, on the 16th, was a very conſiderable one, appears both by the great Expanſion of the luminous Matter from it's Riſe in the N towards the S, and by the Return of the Brightneſs ſeen at *Vienna* on the ſubſequent Days. At *Mantua* the Northern Light reached the *Zenith*, and it is more than probable it did ſo in our more Northern Horizon: Wherefore, as the Matter was collected at the *Zenith*, the Light was reflected thence to all Parts of the Sky. But as the lower Region of our Atmoſphere was at the ſame Time overſpread with Vapours of a certain uniform Denſity, and entirely proper for ſeparating an homogeneous Light; thoſe Rays of the heterogeneous Light, which are the leaſt refrangible, or which produce the red Colour, were accordingly ſeparated by Reflexion and Refraction in great Quantities, and coloured the whole Sky with a fiery Redneſs. And where the Light was brighteſt, *viz.* between the N and W, which is generally the Focus of *Auroræ Boreales*, there likewiſe the Redneſs was ſtrongeſt.

XXXIV. 1. I have incloſed a Draught of the *Parhelia* ſeen in *Kent* the 19th of *December* laſt, as I took it from a private Letter ſent from thence to a Gentleman in this Town: The Writer of the Letter is not ſo particular in his Account of it as could be wiſhed: His Words were to this Purpoſe: "As to the Appearance of the Mock-Suns on the "19th of *December*, I have incloſed a Scheme, ſuch as I could draw, "in which you may obſerve *S* is the Sun, *Z* the *Zenith*—$\alpha\ \alpha$ an in-"verted Rainbow of the moſt lively Colours; the Mock-Suns *d d* were "ſometimes almoſt too bright to look upon, and then they ſeemed "round, but often were fringed (as drawn) with the priſmatic Colours; "the

A Repreſentation of the Parhelia *ſeen in* Kent, Dec. 19, 1741, *by the Rev. Mr* H. Miles. No. 462. p. 46. *Read* Feb. 25, 1741-2. Fig. 30.

" the Arch *b b* was but faint, and a whitiſh Light in the inner Part de-
" ſcribed at *c*. The Appearance ended about Noon, or rather a little
" before twelve; how early the whole was to be ſeen, I do not know."
The two largeſt Semicircles, I find no Notice taken of.——

On *Tueſday* the 19th Inſtant, at 10 at Night, being the Time I generally regiſter the Account of the Barometer and Thermometer, I found the Mercurial Thermometer abroad, at 20 Degrees above 0, or freezing Point: This I thought extraordinary, and for that Reaſon I conſulted my Regiſter of laſt Year, and found 16 Mornings and 13 Evening in *May* colder Air. And in *April* there were two Mornings and three Evenings only, a warmer Air.

Wind was Weſt all Day 19th, and began to riſe when I made the Obſervation, at going to Bed.

Of the ſame, by Mrs Tenniſon, *Ibid.* p. 48.

2. " Dr *Stukeley* likewiſe gave in a Scheme of the ſame Appearance,
" as it was ſeen at *Canterbury* $10^h\ 12'$, *Dec.* 19, 1741, in which the
" Light at *c* was not taken Notice of. He copied it from a Drawing
" made by Mrs *Tenniſon*, who ſent it in a Letter to his Grace the Arch-
" biſhop of *Canterbury*." *C. M.*

An Obſervation of an Anthelion ſeen at Wittemberg, *by* J. Fred. Weidler, *Prof. Math. and F. R. S.* No. 454. p. 221. July, *&c.* 1739. Fig. 31.

XXXV. *Jan.* $\frac{18}{7}$, 1738. One of my Auditors, as he was meaſuring the Fields in a Plain near *Wittemberg* before Noon, happened to ſee an *Anthelion*, or Image of the Sun oppoſite to the true Sun, ſituated in the North. About 8 in the Morning, the Sky was very clear. About 9 ſome Clouds aroſe in the North, and there condenſed by Degrees, and about Noon extended themſelves farther. At $9^h\ 30'$, when dark Clouds had almoſt touched the *Vertex*, there appeared in them a Sun oppoſite to the Sun, of equal Magnitude, round, very bright, ſo that the Eye could not bear it's Splendor, encompaſſed with an oval Crown, or Halo. The greater Diameter of the Crown was about 5 Diameters of the Sun, and the leſſer about 3. The Crown itſelf was adorned with red and yellow Colours, the red being turned toward the Anthelion. The Tract of Clouds within the Crown was yellow, and here and there red. In the Anthelion 2 Portions of an *Iris* croſſed each other under an Angle of about 60°, and turned both to E and W, and were continued to the Circumference of the oval Crown; as *Hevelius* alſo obſerved *Sept.* 6, 1661. The *Phænomenon* continued a Quarter of an Hour; for when the Clouds were extended farther to the S. and hid the true Sun, the Anthelion diſappeared. It ſnowed a little at 11. In the Morning the Wind blew gently from the S W.

An Account of a Meteor ſeen in the Air in the Day-time, Dec. 8, 1733, *by Mr* Crocker, *at* Fleet *in* Dorſetſhire.

XXXVI. The Sun ſhining bright, the Weather warm, and Wind at South-Eaſt, ſome ſmall Clouds paſſing, I ſaw ſomething (between 11 and 12) in the Sky, which reſembled a Boy's Paper Kite, which appeared towards the North, and ſoon vaniſhed from my Sight, being intercepted by the Trees which were near the Valley where I was ſtanding. The Colour of it was of a pale Brightneſs, like that of burniſhed

or

or new-washed Silver. It darted out of my Sight with a seeming Co- No. 456. p. ruscation, like that of Star-shooting in the Night; but had a Body 346. Jan. &c. much larger, and a Train much longer, than any Thing of that Kind 1740. I had ever seen before. At my coming home, one *Brown* assured me, he had seen the same Thing, for the Continuance of a Minute; and that the Body and Train appeared to him to be about 20 Foot long, and seemed to him to fall to the Ground somewhere about the Kennel-garden, whither I accompanied him in Expectation of finding some of those Gellies which are supposed to owe their Beings to such Meteors: But we might have searched long enough, as I understood the next Day, when Mr *Edgcombe* informed me, that he and another Gentleman had seen the same Appearance at the same Time about 15 Miles from us, steering the same Course from E to W, and vanished from them between *Walkhampton* and *Oakhampton*: They gave the same Account of it's Figure, Length, and Colour.

XXXVII. As I was observing *Mars* near a small, fixed Star, then in the West, on the Top of my House in *Buckingham-street*, about 5′ after 8, equal Time; happening to turn my Face Southward, I was surprized with an uncommon bright Glade of Light. It was strait, about 2 ½ Degrees broad, and 110, or 120 Degrees long, ill defined at either End, but pretty well at the Sides, that is, much as the common Rainbow, or one of those Pyramids which are used to dart up from the Horizon in an *Aurora Borealis*, which Light it resembled in all Respects, except in it's Place and Position, and that this was steady, and altogether without that tremulous Kind of Motion, which usually accompanies that. Besides *Saturn*, *Mars*, *Venus*, and the fixed Stars, there was then no other Light in the Sky, nor the least Cloud, nor any of that horizontal Blackness which we see Northward in the *Aurora*. The Stars were as discernible through it, as if nothing had been there. A Gentleman who was with me, fansied it to be the Tail of a Comet; but as neither he nor myself had ever seen one, I gave but little Heed to that Conjecture: However, I carefully directed a 17 Foot Glass to all Parts of it's Western Extremity, but could discern nothing like a *Nucleus*. When I first saw it, it extended itself from about the Midway between *Aldebaran*, and *Orion*'s left Shoulder, through *Gemini* a little under β, and so on through *Cancer* and *Leo*, just above *Cauda Leonis*, till it arrived between *Vindemiatrix* and *Coma Berenices*, where it ended very dilutedly. In about half an Hour it grew dim about the Middle, where in a short Time it separated in two, or rather became quite dark there; but then methought the disjoined Parts were more luminous than before; but they too in a little while after grew dimmer, and shortened away, on to their remote Extremities, which remained visible the longest; the Western one about 9, the Time of it's Extinction, being near *Orion*'s right Shoulder, and the other near the left Knee of *Bootes*; so that this Meteor seems pretty nearly to have accompanied the Earth in it's diurnal Motion, and to have had little or no Motion besides.

An Account of a luminous Appearance in the Sky, seen at London, March 13, 1734-5, *by* John Bevis, *M D.* Ibid. p. 347.

beſides. I have looked for this Light ſince, but could find nothing like it.

The Day was exceeding fine, and by my Journal I find, that,

At Noon, the Barometer was	— — — — —	29.98.
Thermometer	— — — — —	57.
Wind	— — — — — —	Eaſt.
Decl. of the Needle	— — — —	14° 10′.
At 10 at Night, Barometer	— — — — —	29.86.
Thermometer	— — — — —	57.5.
Decl. of the Needle	— — — —	13° 50′.

Meteors obſerved at Philadelphia *in* North America *by* Joſeph Breintnal. Ibid. p. 359. *Dated* Philadelphia, May 9, 1738.

XXXVIII. The remarkable *Aurora Borealis*, that was ſeen in *Europe* the Beginning of laſt *Dec.* was not ſeen here.

But we had a viſible *Aurora Borealis*, *Dec.* 29, 1736. The Day was clear, with a briſk cold Wind N W, the Evening calm and ſerene, and about 7 we had a red *Aurora Borealis*.

Nov. 19, 1737, about Sun-ſet, many People in this Town ſaw a fiery *Meteor* in the Air, large and bright; it ſeemed in the *Zenith*, and ſo it ſeemed to them ſome Miles from Town; it was obſerved to be higher than the lower Clouds.

Dec. 7, 1737, a Minute or two before 11 at Night, we had two Shocks of an Earthquake, greater than ever felt here before. The ſecond Evening after, and for ſeveral Evenings in this Month, a red Vapour appeared to the S and S W, like the *Aurora Borealis*.

An Account of ſeveral Meteors, by Thomas Short, *M. D.* No. 459. p. 625. *Dated* Sheffield, March 18, 1740-1.

XXXIX. The whole of 1737, having been the moſt irregularly conſtituted Year of any in my Time; not one Month but what had the Weather of all the Seaſons in it, and that not by gradual Tranſitions, but by ſudden Jerks; Summer was dry, *Auguſt* was as cold as Winter, *September* full of great Changes; hence that ſudden and general *Catarrh* in *Octob.* ſucceeded in the latter End of the Month, and all *Nov.* by a fatal *Diarrhœa* among the Poor. From *Nov.* 29, to *Dec.* 5, was mild and warm, cloudy and clear mixed, like Spring Weather; the Wind daily veering from S to N W, and every Night falling back to S W or S. *Dec.* 5, at 5 at Night, the Sky round the Horizon was very cloudy, and clear in the *Zenith*; the Weſt Quarter was all of a deep Blood-red Colour, with Streamers of a very beautiful light Red, not running or dancing with ſudden Occurſions and Mixtures, like the *Auroræ Boreales*, but waving like Vapours, toward the *Zenith*, by N W to N: All the Clouds in the Interim were of a very dark red Colour, except that in the W, which was of a deep Blood-red. After it had continued ſome Time there, the ſame appeared in the N. Under the Clouds, from whence theſe Streamers came, was a Brightneſs ſuperior to that of a full Moon. Then both N and W ſent forth their Blood-like Streamers, one toward the other, which paſſed one another, and came to their oppoſite Funds before they were quite ſpent. Between 7 and 8 at Night, the

Scene

Scene ſhifted E; then that in the W was exhauſted, and that in the N weakened: None of them ſent their Streamers beyond the *Zenith* to the S; only the Clouds in the S. were of a very opaque Red. Laſtly, it removed S E, where the Remainder was ſpent: All was over about half an Hour after ten. I had no Inſtrument to take it's Altitude.

The chief Remarkables of this Meteor were,

1. From whatever Quarter theſe Streamers came, they iſſued out of a thick, deep-red Cloud, under which was hid ſo luminous a Body, that I could have eaſily read on a large Church Bible.

2. Theſe Streamers differed from thoſe of all preceding *Auroræ Boreales*: 1. That they were not white and clear, but a bright Red, like the Surface of arterial or pulmonary Blood. 2. They were not ſmall or narrow, but broad like the milky Way in a froſty Night. 3. They did not dart or fly ſwiftly from the Fund, or luminous Cloud, but moved ſlowly; then ſtood ſtill ſome Space of Time; then ſent out thin red Vapours, through which the Sky and Stars were viſible; theſe quickly ſpent themſelves, and vaniſhed. 4. Not only were their Funds red, but the whole Clouds were thick, and of a deep fiery Red.

3. They were above the Region of the Winds; for, though the laſt was S W, yet they moved from N to W, as quickly as from W to N.

4. Whilſt the Sky on the *Zenith* was of the common azure Blue, that in the S, on the opening of the Clouds, was a deep blueiſh Green, like Graſs.

5. The whole Time was attended with an extraordinary Heat of the Air for the Seaſon; for I was obliged to ſtrip to the Shirt, though abroad in the Air all the Time.

6. This Meteor was ſeen at *Venice* at the ſame Time; and, over *Kilkenny* in *Ireland*, it appeared like a great Ball of Fire, which burſt with an Exploſion, that ſhook great Part of the Iſland, and ſet the whole Hemiſphere on Fire; which burnt moſt furiouſly, till all the ſulphureous Matter was ſpent.

7. This Meteor put an End to the Remains of both the *Catarrh*, and watery *Diarrhœa*; and reſtored general Health, till the next epidemic *Catarrh* among the Infants in *February* 1738, two Months after.

The next Meteor was on *Aug.* , 1733, a clear, calm, exceſſive hot Day, at 9 at Night, a frightful Glade of Fire, or *Draco Volans*, from E to W.

Oct. 1, 1736, Day cloudy, Wind S W, clear Evening, 6 at Night, fell a great Ball of Fire out of the Air to the Earth, no Rain 15 Days before, and only a few Drops two Days after.

Aug. 28, 1738, five *p. m.* Wind S W, Sky clear, the Sun bright ſhining, a fiery Meteor appeared N E, ran N, like a Spear of Fire, with a great round Head, which burſt like a Rocket, ſpread about in a large Fire, and vaniſhed ſuddenly. This was a great Drought, which continued without Rain to *September* 7,

The

The next was *Dec.* 2, 1739, ſix at Night, Wind N, Sky clear, a white Froſt, a great *Halo* about the Moon. This Meteor appeared like a large round Body of Fire, of about a Foot and an half Diameter; ſeemed very low, therefore could not be obſerved far, though it went all over this Country from N to S, pretty ſharply, but nothing near ſo quick as a Glade of Lightning, was ſucceeded inſtantly by a moſt diſmal Sound in the Air, like Carts, Drums, and Groans mixt: It kept the Track of the Meteor, but in an oppoſite Courſe, *viz.* from S to W. This was a moſt frightful Time of Rains, Snow, Storms, *&c.*

As to the *Auroræ Boreales*, the moſt remarkable were, 1. That of *Sept.* 14, 1736, Wind N W, Sky clear, next Day very rainy. This exactly reſembled a Crown nobly adorned with the richeſt Jewels; it's concave Side facing the W, and it's Convex reaching near the *Zenith*.

2. *September* 3, 1737, Wind N W, the Day was very rainy, and the Night a clear Froſt. About one in the Morning, was another *Aurora Borealis*, like a Crown, it's concave Side full of Streamers, ſeveral Times red, had very ſwift Motions; but the ſplendid Crowns ſtood ſteady and fair 2 or 3 Hours. We find an Inſtance of the like over *Bohemia* in the *Philoſophical Tranſactions*.

The common late *Auroræ* were, 1736, *October* 16, 17, 18, Wind S, all three Days ſhowery, the Nights bright and clear. *March* 10, 1737, Wind W a Day and Rain, S at Night and clear. *September* 16, Wind W, clear Night. 17, Wind W, a Shower in the Day, and clear at Night. 19, 20, 21, Wind W, all fair, ſome little Froſt. *October* 13, 14, Wind N, clear Days, froſty Nights; the 15th was much Rain. *March* 7, 1738, Wind S W, Streamers reddiſh, Day cold and cloudy; the 8th was rainy; 30th, Air temperate, Wind N W, Day driſling, next Day fair and clear. *February* 4, 1739, Wind N W, Day and Night clear; next Day ſnowy; 23, 24, both Days clear, Wind W; the next Day good. *March* 1, Wind W; that Night froſty, the next after clear and good. *Sept.* 13, 14, 15, Wind N W in the Morning, and S W by S at Night; all 3 Days ſhowery or driſling, Nights clear; 18, 19, Wind E, cloudy fair Days. *Oct.* 22, at Night, Wind North, cloudy; appeared a frightful, fiery Dragon, ſeen over all *England*. This Month was the only good Weather from the 6th Day to the End, that this Country had that Harveſt. *Nov.* 25, Wind N W, cloudy Day, with a Shower, clear froſty Night, with *Auroræ Boreales*. The next I ſaw was on *October* 6, 1740, Wind W N W by W; Day clear, a ſmall Shower, a froſty Night. *February* 28, 1741, Wind N W. *March* 5, Wind S. 6th, Wind W, then N. 9th, Wind S: All droughty Weather, with ſmall Froſts.

Our Northern Lights have been much ſeldomer, and fainter, both in Appearance and Motion, than formerly; and whether they will dwindle away and vaniſh wholly for ſome Years, or whether they have had their former periodic Returns, is not certain: Nor is it leſs dubious, whether they affect our Weather, Seaſons, and Animal Bodies, or not.

XL. *December* 11, 1741, at ſeven Minutes paſt one in the Afternoon by the common Clocks, a Globe of Light, ſomewhat larger than the horizontal Full-Moon, and as bright as the Moon appears at any Time while the Sun is above the Horizon, inſtantaneouſly appeared, in a blue clear Sky, about the S S E, moving towards the E. with a continual equable Motion, and leaving behind it a narrow Streak of Light, whiter than the Globe itſelf, throughout it's whole Courſe. Towards the End it appeared leſs than at the Beginning of it's Motion; and within 3, or at moſt 4′′, it ſuddenly vaniſhed. It's apparent Velocity was nearly equal to half the Velocity of thoſe uſual Meteors commonly called falling or ſhooting Stars: This may be thought an indeterminate Way of expreſſing it's Velocity, as thoſe falling Stars vary in the Swiftneſs of their Motions; but if ſuch be underſtood as have a mean Velocity, between the ſwifteſt and the ſloweſt, it expreſſes, in the beſt Manner I can think of, the apparent Velocity of it's Motion.

An Account of a Meteor ſeen at Peckham, Dec. 11, 1741, *by* Tho. Milner, *M. D.* No. 464. p. 138. *Read* June 24, 1742.

The narrow luminous Streak remained very diſtinct after the Globe was gone; and gave a fair Opportunity for taking the Elevation of this *Phænomenon* above the Horizon, at the Beginning and End of it's Motion, *&c.* had there been proper Inſtruments ready at hand: This not being the Caſe, I gueſſed the Elevation of the Globe, when it firſt appeared, was near 30°. But ſome Days after, being exactly in the ſame Situation as when I ſaw this Meteor, I took the Elevation of a ſmall Cloud, which appeared to be in the ſame Place, with a Quadrant of two Feet Radius, and found it to be but 20°. This luminous Track, or Path, ſeemed a right Line, not quite parallel, but a little inclined to the Plane of the Horizon, *viz.* higheſt towards the Eaſt. It was at firſt very narrow, and pointed at each Extremity; but ſoon grew broader, and within 20′ after the Appearance, which was the laſt Time I ſaw any thing of this Affair, it appeared exactly like a long, bright, rare Cloud, diſcontinued in two Places, above three Times it's firſt Breadth, and a little more inclined to, and elevated above, the Horizon, than it was immediately after the Motion of the Globe.

XLI. *Thomas Savory*, *John Walker*, and others of Lord *Lovell*'s Ploughmen, being at Plough about the Middle of *Auguſt* 1741, on a fair Day, at 10 in the Morning, ſaw on a Heath, about a Quarter of a Mile from them, a Wind like a Whirlwind, come gradually towards them, in a ſtrait Line from E. to W. It paſſed through the Field where they were at Plough, tore up the Stubble in the ploughed Ground, and alſo the Graſs beſides the ſame, for two Miles in Length, and 30 Yards in Breadth. When it came to ſome Cloſes at the Top of a riſing Ground, called *Ferrybuſh-Cloſes*, *Philip Henning*, and others, who were houghing *Turneps*, ſaw it appear like a great Flaſh or Ball of Fire. After having ſeen the Wind come into the Cloſes, *Robert May* was in a Cottage where he lives by a Road-ſide, at the Bottom of the Park, about a Furlong down-hill from the Cloſe, when one of his Children about 6 Years old, whowas playing at the Door, cried out, That *Ferry-*

An Account of a Meteor ſeen near Holkam *in* Norfolk, Aug. 1741, *by the Right Hon.* Thomas *Lord* Lovell, *F. R. S.* No. 465. p. 183. *Read* Nov. 4. 1742.

buſh-Cloſes were on Fire; on which he went out to look, but ſaw no Fire, only a terrible Smoak, and heard ſuch a Noiſe as Fire makes when a Barn is burning. He then ſaw the Wind come from the Cloſes in the ſame Manner as before-mentioned, making a terrible Noiſe, like that of a violent Fire; alſo like Carts over ſtony Ground, which paſſed by his Houſe, tearing up the Stones in the Road, and tore up a Rank of Pales, and ſprung ſeveral of the Poſts out of their Places, and carried a Pewter Plate that ſtood on the Outſide of the Window, about 40 Yards from the Houſe; and a large Box-cover about an Inch and half thick, and 4 Feet ſquare, and croſs-barred, which he covers his Birds with, was carried away much further, and torn all to Pieces; and the Gravel flew about, and alſo the Flint-ſtones like Feathers. It alſo broke down ſome of Mr *Knotts*'s Fences, and frightened the Cattle in a terrible Manner. And, what is moſt remarkable, that every-where elſe but in this Place the Weather was clear and fine, and no Sign of any Storm or Diſturbance whatſoever. About a Quarter of an Hour after, *Philip Henning*, and two of his Partners, *Turnep-boughers*, who were at Work about two Furlongs off, came to the ſaid *Robert May*, and told him, they were glad to ſee him alive; for they expected, that he and his Family, Houſe and all, had been deſtroyed, having ſeen the Fire go that Way, and heard a Noiſe, as if the Houſe had been demoliſhed. *Robert May* ſmelled a moſt terrible Smell of Sulphur, both before and after the Wind paſſed him, and heard the Noiſe a great while after ſeeing the Smoak, before he ſaw the Wind, an Hedge intercepting his Sight. He ſays it moved ſo ſlowly forward, as to be near 10′ in coming from the Cloſes to the Houſe.

Concerning a Ball of Sulphur ſuppoſed to be generated in the Air, by Benjamin Cook, *F. R. S.* No. 451. p. 427. *Dated* Newport (Iſle *of* Wight) July 9, 1733.

XLII. The great Heats we have lately ſuffered, were uſhered in by a very gloomy Night of almoſt continual Lightning, accompanied with very loud Claps of Thunder, which, as uſual, were towards the Morning followed by very heavy Showers of Rain. Early next Day, in a Meadow near the Sea-ſhore, far from any Houſe, and where it has not been known that any Improvement has been carried on, a Huſbandman found a beautiful yellow Ball lying on the Turf, which he gladly took up, in Hopes it would well reward him for ſtooping.

But it proved to be of Sulphur, of which it ſmelt uncommonly ſtrong. It was froſted, as it were, all over with an Efloreſcence of fine, ſhining, yellowiſh Cryſtals, which ſoon fell off with the lighteſt Touch.

Fig 32. It has on one Side a deep Hole *A*, admitting the End of a middle-ſized Knitting-needle, and on the oppoſite Side a deep Depreſſion *B*; which would induce one almoſt to think it's Form had been at firſt nearly ſpheroidal, formed by a Revolution round a ſuppoſed Axis drawn from *A* to *B*. It has ſeveral other Holes ſcattered irregularly up and down it's whole Surface, ſome fit to admit a Hog's Briſtle, others a Hair; as if it had been made of a fine Powder, and ſome thin Liquid, and after mixing had ſuffered ſome Fermentation; but thoſe Parts of it which

which are ſolid, ſeemed more compact than thoſe of the common roll Brimſtone of the Shops, and the Powder of it burns with a whiter Flame, and leſs acid Fumes. It's longeſt Diameter is betwixt eight and nine, and it's ſhorteſt betwixt $\frac{6}{10}$ and $\frac{7}{10}$ of an Inch; it's Weight is 108 Grains. To ſave more Words, I have roughly deſcribed two Sides, one of which has the Hole *A*, the other the Depreſſion *B*.

We find frequent Mention in the Deſcription of Thunder-Storms in hot Climates, that there falls often a flaming bituminous Matter to the Ground, which ſometimes burns not to be ſoon extinguiſhed, but more frequently ſpatters into an infinite Number of fiery Sparks, doing incredible Damage where they ſtrike, always attended with a ſulphureous, ſuffocating Smell, commonly compared to that of Gunpowder.

Whether this ſulphureous Ball was intended for one of theſe, but by ſome Accident miſſed firing, it is now Time to conſider.

Had it been formed in the Earth, how ſhould it get to the Surface, without loſing that moſt elegant, froſty Covering of fine ſhining Cryſtals, and appear not in the leaſt ſullied, or it's Pores filled with Earth, or other terreſtrial Matter; on the contrary, not the leaſt Adheſion of any thing of that Kind can be obſerved: Beſides, Brimſtone made the ordinary Way, ſeems to have a different Texture of it's internal Parts from this Ball. From theſe Obſervations I am ready to conclude it not formed in the Earth; but however ſubmit it to the Determination of the Curious.

XLIII. 1. Being on the Mount in *Kenſington* Gardens at a Quarter paſt 10, the Sun ſhining bright, in a ſerene Sky, I ſaw towards the South a Ball of Fire, of about 8 Inches Diameter, and ſomewhat oval, which grew to the Size of about 1 ½ Yard Diameter. It ſeemed to deſcend from above, and at the Diſtance of about ½ a Mile from the Earth, took it's Courſe to the Eaſt, and ſeemed to drop over *Weſtminſter*. In it's Courſe it aſſumed a Tail of 80 Yards in Length; and before it diſappeared, it divided into 2 Heads. It left a Train of Smoke all the Way as it went; and from the Place where it ſeemed to drop, there aroſe a Smoke which continued aſcending for 20′ (as another Gentleman and I obſerved by our Watches); and at length formed into a Cloud, which aſſumed different Colours.

An Account of the Fire-ball ſeen in the Air, and of the Exploſion heard, on Dec. 11, 1741, *by the R. Hon. the Lord* Beauchamp, *near* London. No. 461. p. 870. Aug. &c. 1741.

2. In the Afternoon, between twelve and one, all this Part of the Country was alarmed with a moſt terrible Clap of Thunder, as it is generally imagined. The Sound came from the N, where the Weather appeared very black and dark all the Morning. The Sound was double, as if 2 very large Cannons had been diſcharged at the Diſtance of about 1″ from one another. Moſt People thought, juſt at the firſt hearing, that it was the Diſcharge of Cannons, till by the rolling and ecchoing of the Sound afterwards, they were convinced it was not. Our Neighbours thought ſome Powder-Mills had been blown up; and I look upon them to be no bad Judges in ſuch Kind of Blaſts, having been more than once alarmed with them, by the Powder-Mills in the Neighbour-

Concerning the ſame Meteor in Suſſex, *by* John Fuller, *Eſq; jun. F. R. S.* Ibid. p. 871.

hood. I have it by Report, that a Countryman, at Work in the Fields about 7 Miles N. of us, ſaw a Flaſh of Lightning before he heard the Noiſe, but I cannot anſwer for the Truth of it: It is very eaſy to imagine, that Fancy and Fear in a poor Countryman upon ſuch an uncommon Occaſion, might conjure up the Idea of Lightning. If it was Thunder and Lightning, the Effects of it muſt be very terrible ſomewhere; for it gave the ſame Report, and ſhook all the Houſes juſt in the ſame Manner, that were above 20 Miles diſtant from one another N. and S; which I think is an Argument, that it was more general than Thunder can poſſibly be.

Concerning the ſame Meteor in Kent, *by the Rev. Mr* William Goſtling, *Minor-Canon of the Cathedral Church of* Canterbury. *Ibid.* p. 872.

3. About one in the Afternoon I found my Houſe violently ſhaken for ſome Seconds of Time, as if ſeveral loaded Carriages had been driving againſt my Walls; and heard a Noiſe, which at firſt my Family took for Thunder, but of an uncommon Sound. For my own Part, (as I thought Thunder which would ſhake us at that Rate, would have been much louder) I concluded it an Earthquake: And, going immediately to the Top of my Houſe, found the Sky cloudy, but nothing like a Thunder-cloud in View; only there was a Shower of Rain from the Eaſtward preſently after, and the coldeſt that I have felt. I thought it the Shock an Earthquake, as I told you before; but ſince find it was attended (and I ſuppoſe cauſed) by a Ball of Fire, which paſſed with great Rapidity over our Country, from Weſtward to Eaſtward, for how long a Journey I cannot tell. It began with 2 great Blows, like the Reports of Cannon (which the jumbling of my Saſhes prevented my diſtinguiſhing); and then rolled away till it was heard no more. The Appearance, I hear, was as that of a very large ſhooting Star; and it left a Train of Light, which ſoon diſappeared, it being Noon-day. I met a Pilot To-day coming from *Deal*, whom I aſked about it; and he told me he ſaw no Fire-ball, but heard the Noiſe, and that it made the Ship ſhake he was in, going from *Graveſend* to the *Nore*.

Canterbury, Dec. 13

——*In* Suſſex, *by Mr* Chiſ. Maſon. No. 462. p. 1. *Read* Jan. 7, 1741-2.

4. At *Buckſteep* in *Warbleton* Pariſh, in the County of *Suſſex*, about ¼ before 1 in the Afternoon, I obſerved a very dark, uncommon Appearance in the N, and at the ſame Time the Sun ſhone bright at my Back; when, on a ſudden, there was an Exploſion, as violent as the Report of a Mortar-piece, attended with a rumbling Eccho, which run Eaſtward; and as near as I could conjecture, it came from about 40° of Elevation. Several People ſaw a Ball of Fire, which ran nearly Eaſtward, leaving a Train of Light, which continued ſome Time. The Ball of Fire was ſeen, and the Report heard very loud, at *Sompting*, beyond *Shoreham*. Although I had been gazing upon the black Cloud for ſome Minutes, yet I ſaw no Fire nor Lightning.

——*At* Newport, *in the* Iſle of Wight, *by Mr* Benj.

5. I did not ſee the *Phænomenon*, but a Gentleman of my Acquaintance was on a Hill about 3 Miles W. of this Town, and had a very advantageous View of it. He ſays, that at that Time the Brightneſs

neſs of the Sun was a little obſcured by the Interpoſition of ſome thin Clouds, when he ſaw it paſs by to the Eaſtward, at about the Diſtance of ſomething more than a Quarter of a Mile, and apparent Height of 30 Feet above the Level of the Place where he ſtood. It's Colour was that of a burning Coal; it's Figure a Cone, whoſe Length might be 8 Feet, and Diameter at the Baſe 18 Inches. From about it's Apex, which was it's hinder Part, iſſued ſeveral bright Streams ſparkling with fiery Drops, to the Length of about 4 or 5 Feet. It's Motion was nearly parallel to the Plane of the Horizon, and it's Direction (as near as we can find by comparing the Places it paſſed over) from S W by S to N E by N, without any Noiſe, Wind, or Motion of the Earth attending it. The Time of it's Appearance did not happen to be taken Notice of with the deſired Exactneſs; but by the beſt Obſervation we can make, muſt be about a Quarter before 1 at Noon. There were a few others who ſaw it, to whom it appeared different in Shape, according to the Point it was ſeen from; and perhaps it's Shape might change as it became nearer conſuming, and only it's Head, in the Form of a Bell, remain at laſt.

Cooke. *Ibid.* p. 25. *Read* Jan. 28, 1741-2.

Fig. 33.

6. About one, *P. M.* coming by Water from the City to *Whitehall*, and near to *Hungerford-ſtairs*, there appeared to me, between *Vauxhall* and *Lambeth*, a Body of Fire: It ſprung upwards in it's Aſcent almoſt perpendicular to the Horizon, to the Height, as near as I could gueſs by my Eye, of 35°, in the Space of a few Seconds, and nearly in Form of a large Boy's Kite, projecting a long Tail towards the North-Weſt, not unlike thoſe of Slips of Paper ſet on Fire: In this State it continued ſo long, that I made the Waterman lay his Oars in, that I might the more eaſily obſerve whether it was the Work of Art or Nature, for I was in ſome Doubt. It had from it's firſt Appearance expanded itſelf conſiderably, ſo that the extreme Breadth was ſeemingly equal to the Diameter of a Full-Moon, ariſing from a duſky Horizon. In this Form it continued aſcending for the Space of 2′, gently ſhooting withal to the N E, till it aroſe to about 45°; then ſuddenly quitting it's Tail, which vaniſhed, colouring the neighbouring Clouds with a Yellow on their Separation, it formed itſelf firſt into a Ball of Fire; then ſhooting quickly to the South-Eaſt in a Stream of Light, diſappeared, making a Noiſe like a Clap of Thunder at ſome Diſtance, and leaving behind it a ſmoaky Subſtance in it's Track.

——*At* London, *by Capt.* William Gordon. No 463. p. 59. *Read* March 4, 1741-2.

The Weather moderate and cloudy, Wind, as nigh as I can remember, W S W. It continued in Sight upwards of 5′.

7. As the Fire-Ball appeared at Noon-day, and the Sun ſhining, few People ſaw it, and they could only gueſs at the Courſe. The beſt Account I have had is at Second-hand, from two Farmers who ſaw it together, and make it's Courſe from N W by N, to S E by S, and right over *Littleborn* (which is the firſt Village in the Road from *Canterbury* to *Deal*). Their Way of telling it's Courſe was by ſaying, it went from *Weſtbere* toward *Ratling*, near which Place Lord *Cowper* was then hunting,

A farther Account of the ſame, by the Rev. Mr William Goſtling. *Ibid* p. 60. *Read* March 18, 1741-2.

ing, and heard but one Exploſion, which ſeemed to be within a few Rods of him: The other, I ſuppoſe, happened at ſuch a Diſtance, as to be in one with that ſo near him.

Two Obſervations of Exploſions in the Air; one heard at Halſted *in* Eſſex, *by the Rev. Mr.* A. Vievar, *Miniſter of that Place; the other by* Sam. Shepheard, *Eſq; of* Springfield *in the ſame County.* No. 455. p. 288. Nov. *&c.* 1739.

XLIV. *Sunday March* 12, 1731-2, between 1 and 2 in the Afternoon, walking in my Garden by the Side of a Canal, I heard as it had been a large Clap of Thunder from the N E, being a very clear Day, and no Clouds appearing. While I was looking into the Air, the Noiſe was repeated very loud, but ſeemed more like the violent Fall of a Houſe, inſomuch that I expected every Moment an Out-cry from the Town: But I was ſoon undeceived, when it began again, and I found it made towards me, with a different Noiſe from what I had heard, that is, like the Grinding of Flint-ſtones, but very loud: The Dimenſions of it ſeemed to be about 3 Foot wide. I found it ſink in the Air, and as it ſeemed to point directly at my Head, I laid myſelf down upon a Graſs-ſlope, to let it paſs over me. However, at the upper End of the Walk I found it fell to the Ground, and came rolling down the Graſs-walk; and I can compare it to nothing better than to that of a violent Grinding of Flint-ſtones, or a Coach and ſix upon the full Speed upon a Cauſway of looſe Stones. I lay attentive, expecting to ſee ſomething, and ſaw a Piece of Wood came running before it. When the *Phænomenon* came to the Water-ſide, it twiſted up a large Stake that ſtood in it's Way, and toſſed it towards me with much Violence, and immediately fell into the Water with the Violence and the Noiſe of a red-hot Mill-ſtone. I have ſeen the Seas break againſt a Rock in a Storm, but never ſaw a greater Ferment cauſed by the boiling of the Waters. It ſtaid about $\frac{1}{4}$ of a Minute in the Water, and then mounted again into the Air, and went rattling away, but with much leſs Violence: I heard it for about $\frac{1}{4}$ of a Mile, and loſt it. *N. B.* It came againſt the Wind, and not faſter than a Man may walk. The Froth and Foam upon the Water remained 30 Hours after, when I ſhewed it to ſome Friends.

Halſted *in* Eſſex,
1731-2.

A. Vievar.

Tueſday *, *March* 15, 1731-2, between 11 and 12, the Sun ſhining very bright and hot, without the leaſt Cloud, the Wind ſo calm, that the Water was as ſmooth as Glaſs, I was dreſſing in my little Room next the Garden, about 40 Yards from the Canal, when I heard a very ſurpriſing Noiſe of Fire, reſembling, as I told you at *London*, as if a very large Quantity of Oil had been thrown into a great Bonfire, burning in it's greateſt Rage. I ſtepped immediately to the Window which was open, where I ſaw the Middle of the Canal, which this dry Seaſon has ſunk about ſix Inches, in extreme Agitation, as rough as the *Thames* in a Storm, foaming and ſmoaking, and forced up, to my Appearance,

* *March* 15 was that Year on a *Wedneſday*. *J. M.*

full

Fig. 28.

Fig. 29.

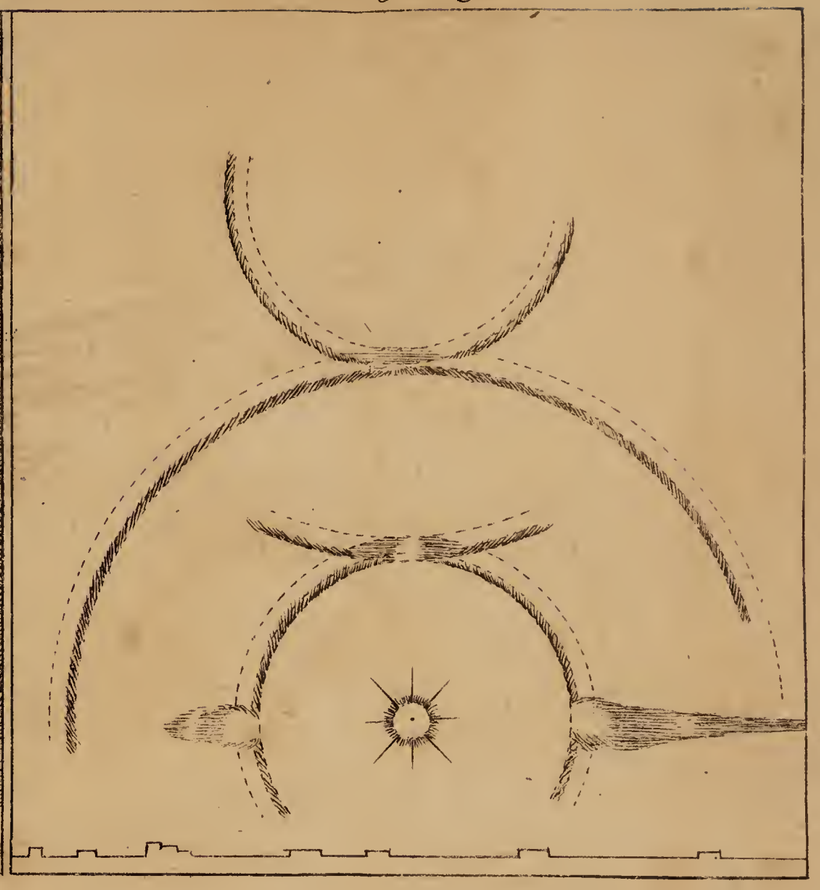


Fig. 30.

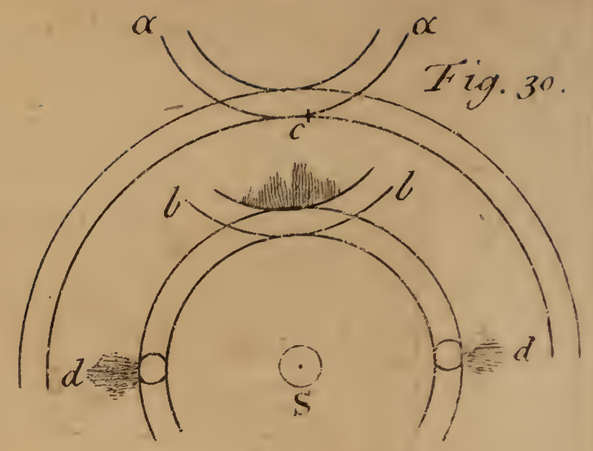


Fig. 32.

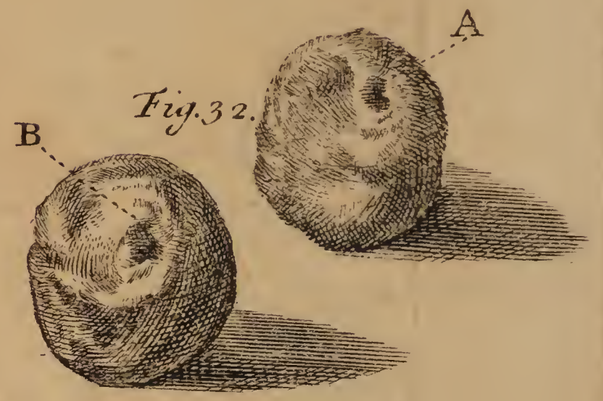


Fig. 33.

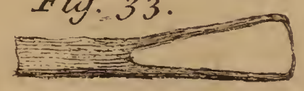
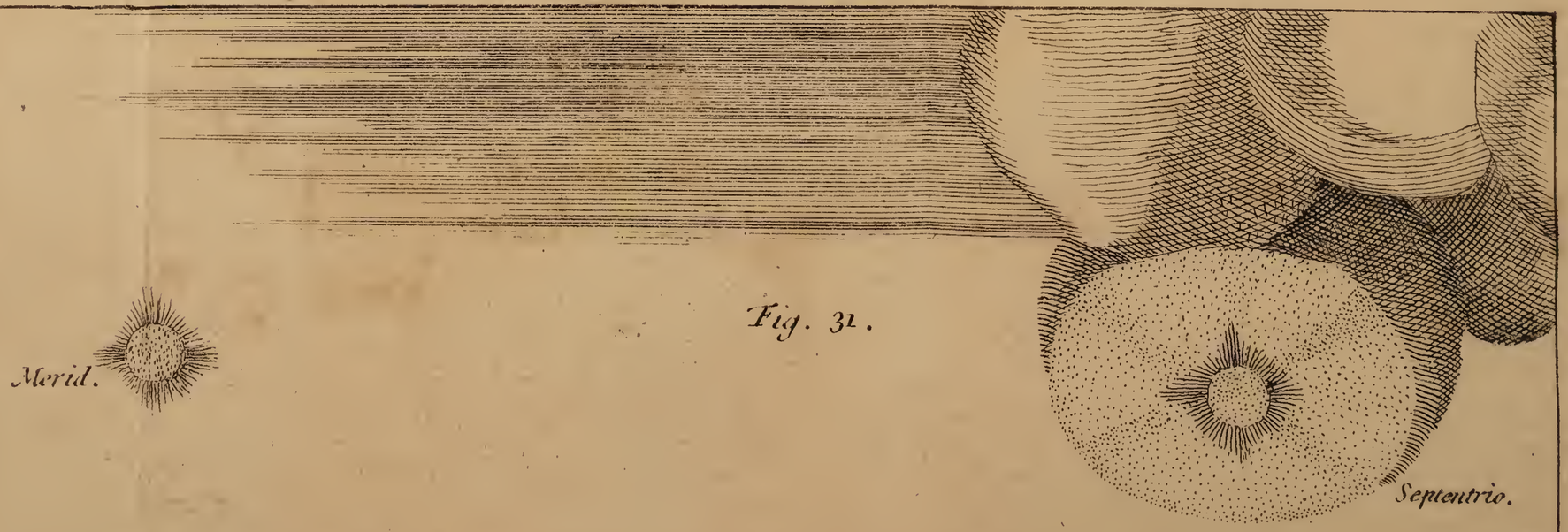


Fig. 31.



Merid.

Fig. 34.

Fig. 36.

Fig. 35.

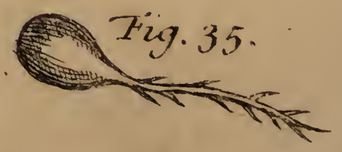
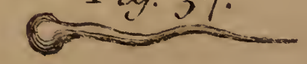


Fig. 37.



full 2 Foot above the Surface, but it might be much more, my Window being greatly higher than the Canal; and the Fellow who was at Work, whom I examined again this Morning, proteſts he ſaw the Water, like the Spray of the Sea, above the Dwarf-Trees, which muſt neceſſarily be 5 or 6 Foot. I wiſh I had ſeen the Beginning of this uncommon *Phænomenon*, the Duration of which, I think, might be ½ a Minute, and made the Houſe ſtink, as if a Gun had been fired in it.

My Canal bears E. and W, and the Fellow ſays he heard it coming from the W, bringing the Leaves of ſome tall Trees from an adjacent Field in it's Paſſage; but could not diſcover any material or ſubſtantial Body to fall in the Water, where the Hiſſing, as I obſerved above, was very loud and violent; neither was there any Lightning or Thunder before or after, but the Day remained bright, ſtill, and hot. I forgot to ſay, the Space of the Canal that was affected by it, might be 12 or 15 Yards.

Springfield *in* Eſſex,
Aug. 22, 1732.

Sam. Shepheard.

XLV. *Octob.* 22, 1725, about 2 in the Afternoon, the Sky being very ſerene and clear, Capt. *Richard Smith* heard, as he then thought, the Noiſe of a Gun, of a Minion Size, about 12 Miles Eaſtward from him, which Noiſe was repeated at leaſt 20 Times, but at unequal Diſtances of Time, and ſoon afterwards followed a very loud Exploſion, as if a Ship had been blown up: Upon Enquiry, he was told by ſeveral Perſons who lived about 12 Miles diſtant from his Houſe, that they were greatly amazed with the Appearance of an extraordinary Brightneſs in the *Zenith*, reſembling Flame, which continued for about 5′, and then the imaginary Guns were fired 20 or 30 Times, which ſo diſturbed the Atmoſphere, that the Birds loſt the Uſe of their Wings, and fell to the Ground in great Diſorder. This Noiſe was heard about 50 Miles each Way, from the bright Appearance aforeſaid.——*Thus far the Captain.*

I heard the Noiſe (as moſt People did) but ſaw not the Brightneſs at *Patapſko*, being about 60 Miles from the Captain's Houſe, I was told that the Shock, occaſioned by the Noiſe, threw down Pewter that was ſet to dry againſt the Side of a Houſe.

An Account of an Exploſion in the Air at Maryland, *by Mr* Richard Lewis. No. 479 p. 120. July, &c. 1733.

XLVI. 1. *Dec.* 16, 1737, (*N. S.*) in the Evening, the Sun being about 25° below the Horizon, a Light was obſerved in the N, as if the Air was on Fire, and flaſhing; the Intenſeneſs of which gradually increaſing, at the third Hour of the Night it ſpread Weſtward in ſuch a Manner, that if a Perpendicular was let fall from the Polar Star, and afterwards a Parallel to the Horizon ſuppoſed, and divided into 6 equal Parts, which Parallel ſhould paſs through the whole Extent of the aforeſaid Light, it is certain, that 5 Parts of the 6 would be towards the W, and only one toward to E.

The greateſt Height of this Light was about 65°; for it occupied the whole Extent of both the *Bears*, and the *Polar Star*: Yet at the Sides it was

An Account of the red Lights, on Dec. 16, 1737, *as obſerved (at* Naples) *by the Prince of* Caſſano, *F. R. S. Tranſlated from the* Italian, *by* T. S. *M. D. F. R. S.* No. 459. p. 583. Jan. &c. 1741.

was not ſo high; for in ſome Places near the N. it aroſe only to 50°, and gradually diminiſhed, ſo as to become inſenſible at the true Horizon.

The above-mentioned Light at it's Extremities was unequally jagged, and ſcattered, and followed the Courſe of the Weſterly Wind; ſo that for a few Hours it ſpread conſiderably wider, yet without ever reaching the *Zenith*.

The greateſt Redneſs and Inflammation appeared half Way, between the viſible Pole and the Northern Point of the Horizon; and in the Middle of this inflamed Part there appeared ſome Streaks leſs inflamed, and moſtly perpendicular to the Horizon; ſome of which flaſhed from Time to Time, while others ſucceſſively vaniſhed. About the ſixth Hour of the Night the Intenſeneſs of the Colour diſappeared; ſome ſmall Traces of the Inflammation ſtill remaining towards the N. E and W, which were all vaniſhed at $7^h \frac{1}{2}$ [of the Night.]

During the greateſt Vigour of the Inflammation, ſome ſmall dark Clouds often croſſed the Light parallel to the Horizon: But the Sky was very clear, except in ſome Parts near the Horizon, where it was much overcaſt with Clouds.

The inflamed Matter, in the greateſt Part of it's Extent, gave a free Paſſage to the Rays of the Stars, even of the third and fourth Magnitude, ſituated behind it. About the fourth Hour of the Night, a very regular Arch of a parabolic Figure was ſeen to riſe gently, to 2° of rectangular Elevation, and to 20° of horizontal Amplitude.

This *Phænomenon* was ſeen all over *Italy*, as appears by ſeveral Accounts of it, though with ſome Diſagreement between them.

But how bright ſoever and diſtinct it appeared, yet it's Cauſe has been deemed by many to be very obſcure: For ſome call it an *Aurora Borealis*, therein following the Opinion of *Gaſſendus*, and deducing all the Appearances from the Laws of ſimple Refraction of the ſolar Rays. Others think it an Irradiation of ſome luminous Comet, placed below our Horizon. Others more politely ſay, it was a new celeſtial Body deſcended from it's upper Habitation down to us, and courteouſly received by the Earth's *Vertex*. Others, in Love with Authority, and *French* Names, have endeavoured to eſtabliſh the Meteor as a Mixture of the two Atmoſpheres of the Sun and Earth; therein tenaciouſly adhering to the new Opinion of M. *de Mairan*, of the *Academy of Sciences* at *Paris*. In fine, others more accurately deduce the Whole from the ſimple firing of a bituminous and ſulphureous Matter, upon account of it's very little ſpecific Gravity, raiſed to the upper Parts of the Atmoſphere, and there, by the claſhing of contrary Winds, broken, comminuted, and at laſt ſet on Fire. This Opinion has been defended with ſtrong Arguments, in the *Peterſburg* Commentaries, by *Mayerus*, upon Occaſion of the Appearance of a ſimilar *Phænomenon* in thoſe Northern Countries.

And,

And, indeed, the preceding Eruption of *Vesuvius*, the Contrariety of the moving Forces, the Readineſs of the Matter to take Fire, the unequal Intenſeneſs of the Light, the Streaks, and all the other Circumſtances obſerved in this Meteor, are plain Arguments of a genuine and real Accenſion. And *Wolfius*, on the Appearance of a *Phænomenon* much like this, which was ſeen all over *Germany* on the 17th of *March*, 1717, is of Opinion, that it ſhould be called imperfect Lightning, as being produced by the inflammable Matter of Lightning: And poſſibly we ſhall ſee the ſubſequent Rains fall quietly, without Lightning or Thunder.

1*ſt*, That it could be a Refraction, happens to be diametrically contrary to the Laws of Refraction; becauſe the Sun was then in the oppoſite Tropic.

2*dly*, The Light ought to have been moſt intenſe in the Eaſt, and weak in it's Elevation; whereas quite the contrary was ſeen to happen. Thus the Whole is accounted for, not by Dioptrics, but by the ſole Laws of direct or reflex Viſion; and the Streaks already taken Notice of, were Spaces containing leſs of the inflammable Matter; whereby the luminous Rays of the neighbouring kindled Matter, being weakly reflected, made the Appearance of a fainter Colour.

3*dly*, The uneven Appearance of the Light at it's Extremities cannot be accounted for by Refraction, but perfectly well by Accenſion: Wherefore I think it rather deſerves the Name of a *Northern Light*, or *Fire*, than that of an *Aurora*: But I leave the further Conſideration thereof to better Heads.

2. The Sky was entirely clear, not only in the Beginning, but during the whole Night. The Wind was at N; which was rather known by the Weather-cock, than ſenſibly felt, the Air being very ſtill. The Quickſilver in the Barometer ſtood at 30 Dig. 24 Dec. (*Engliſh* Meaſure) an extraordinary Height; ſince in the Space of 14 Years, that I have applied with great Care to Meteorological Obſervations, I have but once obſerved the Quickſilver at 30. 48. which I have hitherto looked upon as the greateſt Height.

——*At* Padua, *by* [*the Marquis*] Poleni, *F. R. S. Tranſlated from the* Latin *by* T. S. *M. D. F. R. S. Ibid.* p. 587.

In my Thermometer of M. *Amonton*'s Make, the Height of the Quickſilver was 48 Dig. 78 Dec. And in Monſieur *de l'Iſle*'s Thermometer, which he ſent me from *Peterſburg*, (in which the Heights are changed by the greater or leſſer Denſity of the Mercury, and the Meaſure is taken behind the vacant Space at Top) I reckoned 142.

But before I treat of the Obſervation, it becomes neceſſary to remark two Things, *viz.* that I ſuppoſe, that the Diviſions of the Horizon into Degrees Eaſtward and Weſtward begin from that Point, where the Meridian interſects the Horizon in the N.: And beſides, when I mention the Degrees of the Horizon, or Degrees only, I mean thoſe Diſtances which can be defined by the vertical Circles reaching to the Degrees mentioned.

In ſetting down my Obſervations, I made uſe of apparent Time (*p. m.*) Afternoon.

At $5^h \frac{1}{4}$, there appeared near the Horizon a blackiſh Zone, with it's upper Limb of a Sky-colour, ſomewhat obſcure. Above this Zone was another very luminous, reſembling the Dawn pretty far advanced. The higheſt Zone was of a red, fiery Colour. The Altitudes of the Zones ſeemed to bear ſuch Proportion, that the ſecond was double the firſt, and the third triple: And, at the ſame Time, they in many Places roſe ſomewhat above the 40th Degree of Altitude. Eaſtward they extended to the 55th Degree on the Horizon, and Weſtward to the 70th. They had 3 perpendicular ſlender Diviſions, like Slits; but they were parallel to the Horizon, excepting that the third had ſome Parts of it's upper Limb unequal in Height, with ſome Aſperities upon it; and from the firſt to the ſixth Degree Weſtward, a Sort of Beam wider than the reſt was obſerved. The Stars of Part of the *Great Bear*, the *Dragon*, *Hercules*, and others, appeared more or leſs through the *Phænomenon* (and others afterwards, according as the Appearances varied). But through the lower Zone they appeared more obſcurely, and in ſome Places not at all: Through the middle Zone, they ſhone bright; but through the higheſt, they were leſs diſtinct.

I cannot determine with Certainty the firſt Moment of the Appearance of this *Aurora*: Nor indeed does it ſeem feaſible, to define the Riſe of ſuch *Phænomena* with ſufficient Accuracy. But it is worthy of Remark, that after Sun-ſet on the preceding Days, as well as this, there appeared in the W. a remarkable Redneſs expanded on each Side: And moreover, on the enſuing Evening, the ſame bright red Colour, appearing near the Horizon, deceived the common People into a Belief, that a new *Phænomenon*, like the foregoing, was breaking out of the Horizon. Wherefore I am of Opinion, that in this Caſe there is a conſiderable Difference between the *Aurora Borealis*, and the Redneſs occaſioned by the Sun's ſetting.

About $\frac{1}{4}$ of an Hour after, the Length of the Zones was contracted, their Extremities having receded about 10° from the E. and W. The white lucid Part was not now ſo diſtinguiſhable from the red as before: And this laſt Colour grew fainter almoſt every-where elſe but at the Weſtern Limit, where it was more vivid: But in that Weſtern Space, from which the *Aurora* was withdrawn, there remained a brighter Space of 3 or 4°, ſurrounded by a ſmall black Cloud, ſo that it ſeemed to be a Kind of *Hiatus*. Near our *Zenith* there appeared ſome thin lucid Clouds, partly of a whitiſh Red, in ſuch a Manner, that they ſeemed as if occaſioned by the burning of Houſes at ſome Diſtance to the N. Others of this Sort had happened before, and ſome were ſeen afterwards.

A little after ſix, the upper Parts began to emit red Streamings, or Rays, in Plenty; but in theſe, the Red was now-and-then intermixed with whitiſh and darkiſh Colours.

In

In a few Seconds after, there iſſued forth from the very Æquinoctial W, a red and very bright Column, which aſcended to the third Part of the Heavens; and a little after, it became curved in the Shape of the Rainbow.

At ¾ after ſix, the red Colour appeared fainter, and the Zones were not ſo diſtinct from one another; the *Phænomenen* reached only to the 20th Degree E, but to the W. it retained it's Length, as before.

At 7 the *Phænomenon* appeared interrupted, and divided into two Parts, the intermediate Space becoming almoſt inviſible. The red Part of it's Weſtern Extremity was curved into an Arch terminating near the Horizon. Not far from the 84th Degree to the W, there appeared a Sort of *Hiatus*, not unlike that in the E. already deſcribed, and which had vaniſhed by this Time.

Seven Hours 20′ the whole *Aurora* was become paler, ſo that the red Colour was ſcarce diſcernible, except at the Weſtern End, where it was of the Colour of Fire.

A little after eight, the lowermoſt of the Zones, as they now ſtood, was blackiſh; and above this another whitiſh bright one was ſeen: And ſome Parts of theſe ſeemed to fluctuate, and be agitated (as it often happened before and after); and, if any of them diſappeared, they were ſoon ſucceeded by others.

At ½ an Hour after eight, almoſt in an Inſtant of Time, the bright Zone, from the 8th Degree W. to the 50th E, became more vivid, and roſe higher; and above this appeared a new large one, of a red fiery Colour, with ſeveral ſucceſſive Streamings tending upward, and paſſing 60° of Altitude: The Weſtern Part had aſſumed the Form of a thin Cloud.

A little before nine, at 16° Eaſtward, a curved red Beam, (or Bow) though irregular in ſome of it's Parts, roſe up to the *Zenith*; and at the ſame Time ſuch another, commencing at the Horizon beyond the 80th Degree W, aroſe to the ſame Height, and joined the Eaſtern Arch in the *Zenith*.

At 9, after theſe Beams had been up to the *Zenith* a very ſhort Time, they parted, and began to fall conſiderably lower: But in that Place where they were in Contact, there remained a certain reddiſh Cloud, which gradually changed in Magnitude and Figure: However, I never obſerved it to aſſume that Figure which might properly be called a *Corona*. In ſome Time it vaniſhed, as the other Appearances did from the *Zenith*: Nay, the whole *Phænomenon* grew leſs, and fainter; and was reduced to the irregular Form of bright Clouds and Beams, whoſe Light ſtill diminiſhed.

At ¾ after nine, the Weſtern Part was transformed into the Appearance of one Cloud, of a very red Colour, with very little Roughneſſes on it's Edges; but it was ſomewhat more contracted than before.

A little after 10, the Heavens became brighter from the 84th Degree W, to the 18th Degree Eaſtward, and to 50° high, or better.

At 10^h 36$'$ the *Phænomenon* was contracted, being now about 10° in Longitude ſhorter on each Side. But it's upper Part was very red, as if on Fire, with ſeveral Rods, or narrow Beams, ſhooting from it. In a Word, the Diſpoſition and Brightneſs of it's Parts came very near the Shape and Vigour the *Phænomenon* had at the Beginning.

At 11 the red Part did not afford the Sight of theſe Rods and Dartings; and the Colour being now fainter and pale, the whole *Aurora* was divided into 2 Parts, and the Light was weaker.

In 10$'$ after, the intermediate Sciſſure was larger, being now near 20°; and the Part on the Right-hand ran ſomewhat E.

About 10^h ½, the Redneſs became ſtronger, but more ſo to the W. than to the oppoſite Part.

In ¼ of an Hour, both the Light and Redneſs diminiſhed; ſo that the only Space that retained a vivid Light was that of 6° to the W.

At 12 the Light of the *Aurora* was nearly extinct, there appearing only a very weak Light along the Tops of the Mountains.

Twenty Minutes after, there appeared a white brightiſh Beam, at 30° W, and 60° high; but it ſoon became inviſible.

In ½ an Hour after, a very weak Light remained in the Weſt, near the Horizon; which had not been obſervable, if the Brightneſs of the preceding *Phænomenon* had not invited me to continue the Obſervation.

At ¼ after one, that weak Light was much contracted.

The Tranquillity of the Air continued the ſame, or nearly ſuch, as in the Beginning; and yet there was not the leaſt Report, or even hiſſing Noiſe, heard to iſſue from ſo much Matter.

At 1^h 30$'$, that Part of the Heavens where the *Aurora Borealis* had ſhone forth, was no Ways different from the reſt; and the only Light in the Sky proceeded from the Stars, and the Moon, which was now up.

I had at other Times obſerved ſome luminous Appearances in the Heavens, which may be referred, in ſome Meaſure, to the Claſs of the *Phænomenon* above deſcribed; but I was of Opinion, that the Memory of this ought to be preſerved with the greater Diligence, as it far ſurpaſſed all that preceded it in Magnitude, Light, Figure, Colours, and Duration.

3. The *Aurora Borealis*, which was formerly a rare *Phænomenon*, and almoſt unknown in this our Climate, is now become very frequent. In *Bononia* a great Number have been obſerved for ſome Years paſt, as appears by the Regiſter of the Obſervations made in this *Inſtitute*. This Time it was ſo very remarkable, that I do not think any one remembers to have ever ſeen the like. As to it's Extent, it ſpread ſo as to occupy about 140 Degrees of the Heavens: And, as to it's Light, it was ſo vivid, as by it to diſtinguiſh Houſes at a great Diſtance; which ſeemed of a red Colour, and made ſome People attribute this Light to a Fire in the Neighbourhood. But when they were aſſured what it was, they remained no leſs frighted, ſuperſtitiouſly believing it impoſſible,

——*At the Obſervatory of the* Inſtitute *of* Bononia. *By Dr* Euſtachio Zanotti, *Deputy-Prof. Aſtron. Tranſlated from the* Italian, *by* T. S. *M. D. F. R. S. Ibid.* p. 593.

possible, that such an uncommon Light, and of a red Colour too, like Blood, should appear in the Sky without presaging some unhappy Accident. While the whole City was intent upon viewing this new Appearance, I and some young Gentlemen were employed in calculating the *Ephemerides*; and, being apprized thereof, we jointly began to take Observations of it. This uncommon Light drew to the Observatory several others, that were used to come at other Times: But I shall only relate what is entered upon the Register of Astronomical Observations, leaving to those who are fond of philosophical Hypotheses, to investigate it's Cause according to their Fancy.

7^h 9′, *p. m.* when we first perceived the *Aurora Borealis*, it's Centre was near the N. Pole. The Brightness extended along the Horizon about 70°, and it's Height was judged 20°. The Sky was almost totally overcast with Clouds, but the Light was visible in several Parts, where the Sky was clear. The two Stars, ζ and ε, of the *Great Bear*, shone bright in the Midst of the reddish Light of the *Aurora*.

7^h 34′, no Change having happened for some Time, the Light now appeared somewhat weaker, and removed from it's Place; for it's Centre was no longer in the North, but passed Westward. [N. W.] The Stars, ζ and ε, were still visible, but more Eastward, with respect to that Part where the Light was brightest.

7^h 39′, the Light continued diminishing. To the W, the Sky was quite overspread with Clouds; so that it was not possible to distinguish it's Limits.

7^h 42′, the *Phænomenon* on a sudden re-assumed new Strength, and became more vivid, and of a Colour as red as Fire.

7^h 44′, it again became languid, but was spreading at the same Time. To the E. it was not possible to determine it's Limits, by reason of the Weakness of the Light, which disappeared by Degrees. About the Pole, and to the West, it was lost behind the Clouds.

7^h 49′, it continued to spread wider, and had already taken in the two Stars, β and γ, of the *Dragon's-Head*, and *Lucida Lyræ*.

7^h 52′, the Expansion of the Light still increased, which took in a great Part of the *Swan*, surrounded by a Mist. At this Time the Height of the *Aurora* was 40°, and it's brightest Part was a little under *Lucida Lyræ*.

7^h 54′, on the other Side towards the N, the two Stars, δ and γ, of the *Great Bear* were immersed in the Light.

7^h 59′, the *Aurora* formed itself into a concave Arch towards the Horizon. The Polar Star was near the Top of it's Convexity, and some Stars shone bright in the Midst of the Light; and, among these, δ and γ, of *Ursa major*. The concave Part was terminated by a Basis somewhat dark; which separated the red Light of the Arch from a white and very bright Light, that remained within it. The Arch, which was 15° broad, was of a deeper Colour towards the Horizon than towards the Pole. The Western Limit, which was interrupted by Clouds,

Fig. 38. Clouds, was wider and more irregular than the Eaſtern Limit. Fig. 38 exhibits the *Phænomenon* conformable to the Deſcription now given.

8^h 9′, to the W. the Limit of the Arch remained confuſed, though of a red Colour, ſomewhat vivid: But to the E. it became more faint, and changed rather into a whitiſh Colour.

8^h 19′, the red Light ſpread to the Conſtellation of the *Dolphin*.

8^h 22′, the Arch, which was ſtill diſtinct, grew bigger, paſſing Eaſtward by the two Stars, κ and ι, of *Urſa major*, and Weſtward by the Stars of the *Swan's Tail*.

8^h 29′, *Lucida Lyræ* remained clear of the red Light, which moved higher, and was immerſed in the bright Light.

8^h 30′, at the Eaſtern Limit of the *Aurora*, that is, at 54° from the N. Pole, there was ſuddenly ſeen to riſe vertically up, a Beam of Fire, at firſt of a very bright Light; but, in Proceſs of Time becoming more reſplendent, it changed into a red Colour, like that of the Moon in the Horizon.

8^h 31′, the Light ſtill increaſed in Vigour, and was now entirely like the red Rays, which are ſeparated by the Priſm. It's Figure was changed; for it reſembled a Pyramid, with it's Baſis on the Horizon, 4° wide, and it's Height was about 20°. Near the Top of the Pyramid, the Redneſs was leſs than at the Baſis, and it's Limits were not very diſtinct.

8^h 34′, the red Light continued ſpreading, and made, as it were, a Baſis of a weaker Redneſs, for the aforeſaid Pyramid. At this Time the *Aurora* appeared unſettled and curious, as in Fig. 39. At it's Eaſtern Limit the Pyramid continued viſible, but of a more intenſe Colour towards the North, and from it's Middle there ſhot up vertically a Streak of Light, between a white and a yellow Colour. A very dark narrow Cloud croſſed the whole *Phænomenon*, and went to terminate in the Pyramid. At the upper Part, a conſiderable Track of the Heavens was enlightened with a very vivid red Light, which was interrupted by ſeveral Streaks or Columns of a bright yellowiſh Light. The ſaid Streamings ſhot up vertically, and parallel to each other; and the narrow Cloud ſeemed to ſerve them for a Baſis. Under the Cloud there iſſued forth two Tails of a whitiſh Light, hanging downward on a Baſis of a weak Red, and it ſeemed as if they kindled and darted the Light downward. There was likewiſe ſeen a white Streak, which paſſed acroſs theſe two Tails, and extended from one End of the *Phænomenon* to the other, in a Poſition almoſt parallel to the above-mentioned Cloud. Weſtward the Sky was all cloudy, ſo as to ſuffer nothing to be obſerved. At this Time ſome of the Company perceived other little Shootings, like thoſe which are frequently ſeen in Summer, and are commonly called *falling Stars*. More than one of theſe were obſerved in that Part of the Heavens that was free from the *Phænomenon*, at about 45 Degrees of Altitude, not far from the Eaſt.

Fig. 39.

8^h 36′,

8^h 36′, there re-appeared a Portion of the Arch, which was ſeen at firſt. The Pyramid was ſpreading, and loſing it's Figure.

8^h 38′, the very bright red Light, which firſt formed the Pyramid, ſpread Northward on the Tracks of the Arch; which nevertheleſs contained within it a bright Light extending to the Horizon, excepting that it was covered here and there by Clouds.

8^h 39′, the Stars, ζ, ε, of *Urſa major*, ſhone through the red Light, which contained ſeveral white luminous Streaks.

8^h 44′, the red Light, now very vivid, was all interſperſed with white luminous Streams, which darted out of the Baſis or lower Extremity of the Arch. To the W, the Northern Light terminated exactly in a white Streak, and Eaſtward it ſpread as far as the Horizon. The N. Pole began again to become red, yet there ſtill remained ſomewhat of the uſual bright Light between the Red of the Pole, and that of the Arch.

8^h 51′, the red Arch began alſo to appear to the Weſt, and reached to the Stars of the *Swan*, which at firſt were hid by the Clouds.

8^h 54′, the red Light began to ſpread on every Side, but ſtill contained within it ſomewhat of the Brightneſs. The *Zenith* was now all red, and with it that Part of the Sky which takes in 70° on each Side. Fig. 40 exhibits the *Phænomenon* as it was obſerved at that Time. The Circle deſcribed by the Figure denotes a Parallel to the Horizon at the Altitude of 45°; on which is a Portion of the Arch, ſo often made mention of. Fig. 40.

8^h 56′, there appeared ſeveral white Streaks to the Eaſt, where the Light of the *Aurora* was ſtrongeſt; which Light was riſing higher, and ſeemed to have entirely quitted that Part of the Sky near the Horizon.

9^h 4′, there now remained but a little reddiſh Light at the N. Pole; all the reſt was collected near the *Zenith*, not extending lower than the Star α of *Urſa major*. In the South, where the Sky was clear, there were ſeen ſome of thoſe Stars which we have called *falling Stars*.

9^h 6′, about the *Zenith* the Light continued red and vivid, but deſcended lower. The *Aurora* abandoned the E, and took Poſſeſſion of the N. W. It appeared as if the Coruſcations had almoſt conſtantly taken their Riſe from the Eaſtern Quarter, and afterwards extended to the W.

9^h 9′, a conſiderable Streak, or Track of red Light, more vivid than the reſt, croſſed the Stars of the *Swan* almoſt horizontally.

9^h 12′, in the Eaſt, where the *Aurora* ſeemed to have entirely diſappeared, it began again to make it's Appearance; but to this Time the Light was but faint, in Compariſon of that which was ſeen in the Beginning.

9^h 19′, the Light was become pretty faint, and confined within a ſmall Space, at the Height of about 40° above the N W. Many little Changes that occurred, are not ſet down, it being impoſſible to keep an

Account

Account of them all, inaſmuch as they ſucceeded one another very quick.

9^h $34'$, the *Aurora* ſeemed entirely extinguiſhed. In ſome Minutes after, it began to revive; but the Clouds, which were in great Numbers, and ſpread round on every Side, left but a few little Spaces free. The greateſt Brightneſs was in the *Zenith*, which appeared like a red Veil, declining to the N. where it loſt itſelf behind the Clouds.

11^h $6'$, the Light gathered new Strength, and was all at N. up to 20° of Altitude, the *Zenith* being quite clear of it. The Brightneſs was greateſt about the Pole, and grew weaker as it receded from it, taking in, upon the Whole, 90 Degrees of the Horizon. The Clouds continued to increaſe, and prevented ſeeing the *Phænomenon* but now-and-then; and in this manner the Light laſted to the 13th [1ſt] Hour. Some ſay they have ſeen Foot-ſteps of it at the 16th [4th] Hour; but our Company parted long before from the Obſervatory, thinking it entirely at an End; and the rather, becauſe the Clouds had deprived us of all Hopes of being able to purſue the Obſervation.

I ſhall add ſome things which have been communicated to me by the celebrated Dr *Beccari*, and are of his own Obſervation.

The Day of the *Aurora*, the Barometer was very high, *viz.* at 28 Degrees 5 ½ Lines. The preceding Day, the Winds were different, in different Regions of the Air. Near us [the Earth], the Wind was W. N. W. and pretty cold. Higher up, the Clouds came from the E. and moved Weſtward; which Clouds were globular Collections of Miſts. Above that Region the Wind blew at South-weſt by South, as appeared by ſome ſmall Fleaks of Clouds coming from that Quarter. The 16th Day, the Wind that reigned in the Region of the Clouds was *Greco-tramontana*, and was in the ſecond Degree of Strength.

Several Perſons have poſitively aſſured us, that, in the Evening of the 16th Day, they perceived a certain Stench in the Air, like that which is ſometimes occaſioned by a Fog. The ſame has been taken notice of at other times, when ſuch *Phænomena* have appeared.

There was a very thin Fog in the Air not only on the 16th Day, but alſo on the preceding and enſuing Days. The Mornings of the 17th and 18th, before and a little after Sun-riſe, the Air appeared of an uncommon fiery Colour. The Evening of the 17th, the Crepuſculum was of an extraordinary Height. Between the N. and W. there was ſeen a very thin red Vapour, which laſted almoſt till Night.

The various Appearances of the *Aurora*, obſerved by that Gentleman, are here omitted, becauſe they very well agree with thoſe above deſcribed.

—*At* Rome *by the Abbot* Didacus de Revillas *Pub. Prof. Math. and F. R. S. Ibid.* p. 601.

4. Tho' I was not at leiſure to obſerve a very bright Light in the Heavens till 7^h $30'$, yet I had the following Informations from Eye-witneſſes of good Credit. 1. When the Twilight was ſcarce ended, the N. Part of the Heavens was ſtained with a red and fiery Colour, intermixt afterwards with ſome whitiſh Streaks. 2. A little afterwards the

the Light declined from the N. toward the W. the Streaks ſometimes vaniſhing and then appearing again, reſting for ſome time upon 2 whitiſh concentric Arches, very near the Horizon. 3. Near their Edges a more vivid Light darted from the Horizon. 4. About 7^h the Conflagration travelled again toward the N. and the Arches at the ſame Time diſappeared. Thus much I had from others: The reſt is from my own Obſervation.

At 7^h $30'$ a red and fiery Light illuminated the N. Part of the Sky, which was then ſerene: It roſe to the Height of about 8° and extended 10° to the E. and 35° to the W. and the fixed Stars appeared thro' it. Near the Horizon there was an unuſual whiteneſs in the Sky, reſembling the true *Aurora*.

At $40'$ a blackiſh Streak roſe toward the Polar Star, and in the mean time the red Colour was gradually propagated.

At 7^h $45'$ a great Conflagration was collected between 26 and 30° from the N. toward the W, and two whitiſh Streaks aroſe converging a little in the under Part: A little afterwards the Conflagration roſe to the Height of 40° the N. Part of the Heavens being ſcarce ſenſibly red.

At 8^h the Inflammation was abated, where it had been very bright a little before. But at the N. and at E. N. E. as it went higher, it was kindled again.

At $15'$ the horizontal white Light appeared in all the N. Part under an Angle of Elevation of almoſt 7°, but the Conflagration which occupied the upper Parts tended a little to the Horizon near the N. E. Perhaps this Whiteneſs had the Figure of an Arch, but the Buildings hindered the Sight of it. A little afterwards at 32° to the Weſtward of the N. the red Colour almoſt diſappeared. At the N. and N. E. it was more intenſe. In the mean time, about *Lucida Lyræ*, there appeared an almoſt elliptic *Area*, of a bright red Colour, it's greater *Axis* being perpendicular to the Horizon, and white Streaks were ſent from it toward the Top of the Sky. Another equally white extended from the Bottom of the Ellipſe to the Head of *Urſa Major*. The greater *Axis* of the *Area* occupied about 10°.

At $20'$ this new elliptical Conflagration was raiſed higher, and declining a little from the W. receded from *Lucida Lyræ*, aſſuming a trilateral Figure, or rather that of the Sector of a Circle, the Arch being turned to the Horizon. In the Centre of this Sector was a bright Star in the Breaſt of the *Swan*, much about the ſame time a bright Streak inclining from the burning N. Part toward the Centre of the Sector terminated the almoſt darkened intermediate *Trapezium*.

At $45'$ the lucid Sector diſappeared. A blackiſh Cloud between 28 and 30° from the N. toward the W. almoſt the whole Conflagration was extinguiſhed, except about the Polar Star.

At $50'$ a Light of a blood-like red Colour was again kindled between the Polar Star and the Head of *Urſa Major*, and was extended above

the Height of 60° : In the mean time another Portion of the Heaven was kindled, ſeparate from the former ; toward the W. A little afterwards the intermediate Space was alſo kindled above, a whitiſh and bright Interval being left near the Horizon at N. N. E.

At 9^h a greater Conflagration about the Head of *Urſa Major*, a red Light was diffuſed almoſt to the Zenith, and again toward the W. many blackiſh Streaks converging a little below roſe up within the Conflagration, and the largeſt of them reached to the Polar Star.

At 9^h 10$'$ the Streaks diſappeared, a brighter Conflagration continuing above the Head of *Urſa Major*, and extending itſelf quite to the Horizon, which was whitiſh a little before.

At 13$'$ a greater Conflagration about the Polar Star. But the whole northern Hemiſphere was very red.

At 20$'$ a large whitiſh Streak roſe up to 12° from the N. to the W. and the Inflammation about *Urſa Major* was diminiſhed. Between 30 and 34° it continued ; where the Horizon, being whitiſh toward the W. was ſtill tinged with red.

At 30$'$ it grew very faint, and deeper again near the N.

At 40$'$ it diſappeared again, a faint Light continuing toward the W. which was extinguiſhed by ſlow Degrees.

At 10^h an Inflammation again at the N. which was extended a little toward the E. but between each Stream of Light a Space of about 15° was interpoſed, into which the Inflammation on each Side faded, and collected itſelf again.

At 15$'$ the Sky was cloudy toward the W. the Horizon only was clear. The Conflagration was now extinguiſhed, ſcarce any Redneſs remaining at the N.

At 11^h it revived again at the N. N. E. and continued till Midnight, then it was gradually diminiſhed. But the doubtful Light and Redneſs of the Air which remained, ſcarce diſappeared in 2 Hours afterwards.

On the 16th at	9^h *a. m.*	the Barometer was at	28. 1
	9 *p. m.*	— — — —	28. 1 $\frac{1}{16}$
17	7 *a. m.*	— — — —	28. 1

——*by Mr* James Short, *dated at* Edinburgh, Dec. 6. 1737.

5. Yeſternight we were ſurprized upon looking out at the Windows, about Six, to find the Sky, as it were, all in a Flame ; but upon further Inquiry, it was nothing but the *Aurora Borealis*, compoſed of red Light. There was an Arch of this red Light reached from the Weſt, over the *Zenith*, to the E. the N. Border of this Light was tinged with ſomewhat of a blue Colour. This *Aurora*, as far as I ſaw, did not firſt form in the N. and after forming an Arch there, riſe towards the *Zenith*, as they commonly uſe to do ; neither did the Light ſhiver, and by ſudden Jirks ſpread itſelf over the Hemiſphere, as is common, but gradually and gently ſtole along the Face of the Sky, till it had covered the whole Hemiſphere ; which alarmed the Vulgar and was indeed a ſtrange

Sight: In ſome Places we ſaw the Clouds paſs betwixt us and it. During the whole Time, which was from 5 till 8, there was a moſt violent Wind from the S. W. I looked at *Jupiter* with a 15½ Inch Teleſcope, but the Air was in ſuch an Agitation I could not ſee him diſtinctly. *Lucida Lyræ* appeared through the red Light very dim to the naked Eye. About 8 this red Light formed a *Corona*, a little to the S. of the *Zenith*; and inſtead of a dark Fund in the Middle, as uſual in ſuch Occaſions, it was of a deep Red. There was always a great Circle of this Light came from the W. to the *Zenith*, which ſeemed to be the Magazine whence all the reſt were ſupplied. It is but about a Year ſince I firſt obſerved this red Light in the *Aurora Borealis*, and only then in very ſmall Quantities.

6. It was a ſtrong and very ſteady Light, as near as can be of the Colour of red *Okre*; it did not ſeem to dart or flaſh at all, but continued going on in a ſteady Courſe againſt the Wind, which blew freſh from the S. W. It began about N. N. W. in Form of a Pillar of Light, at about 6^h $15'$ in the Evening; in about $10'$, ¼ Part of it divided from the reſt, and never joined again; in $10'$ more it deſcribed an Arch, but did not join at Top; exactly at 7, it formed a Bow, and ſoon after quite diſappeared; it was all the while lighteſt and reddeſt at the Horizon: It gave as much Light as a Full Moon. ——*by* John Fuller, *jun. Eſq;*

At 8^h it began again exactly N. it was very light then, but not near ſo light as before; in half an Hour it made an Arch from E. to W. and went quite away to the S. when it ended much with the ſame Appearance as it began in the N. but not quite ſo red.

Roſehill, [*Suſſex*]
Dec. 20. 1737.

XLVII. The frequent Appearances of the *Northern Lights* in ſeveral Parts of *Europe* and *America*, and the ſurpriſingly beautiful *Phænomena* that have been obſerved in ſome of them, ſuch as the Rainbow-Colours, Canopy, *&c.* have very juſtly engaged the Philoſophers of the preſent Age in a Search after the Cauſes of them. Several Hypotheſes have been invented and propoſed by the Learned, in order to explain theſe things. Moſt of them ſuppoſe theſe *Phoſphorus*-like Appearances to proceed from certain *Effluvia*, either perſpired out of our Earth, or at leaſt paſſing through it. But our ingenious Author has thought of a Cauſe very diſtant, as well as very different from all theſe, *viz.* the Atmoſphere of the Sun, which at ſome times ſhews itſelf under the Appearance of a Light, which he calls the Zodiacal Light, but at other times produces an *Aurora Borealis*. The Zodiacal Light is the purer unmixed Atmoſphere of the Sun: But an *Aurora Borealis* is the Effect of the Solar Atmoſphere, conſequent upon it's making a Deſcent into, and blending itſelf with the Atmoſphere of our Earth, at certain Times and Seaſons of the Year. But a more particular Account of this Matter will be given hereafter. *An Account, by Mr* John Eames, *F. R. S. of a Book entitled,* TRAITE' PHYSIQUE ET HISTORIQUE DE L'AURORE BOREALE, Par Mr DE MAIRAN. Suite des Memoires de l'Academie Royale des Sciences, Année MDCCXXXI, No. 431. p. 243. Jan. *&c.* 1734.

The learned Author of this Work has taken a great deal of Pains in compiling it. He has looked over the Accounts of Meteors, from the fifth Century down to the preſent Time, in the Hiſtorical Part; and has ranged them in very good Order, in Regard of the ſeveral Returns of this *Phænomenon*, making ſuch Remarks by the way, as ſerve to ſupport his Solution of it in the Philoſophical Part.

By a Return he does not mean barely a ſingle Appearance, but a Series of them after a Ceſſation or Non-appearance for ſeveral Years. Thus he makes but twenty-two Returns from the Year 400 to 1716, while the ſeveral Appearances of theſe Lights from 1707 to 1710, after a ceaſing to be ſeen for 20 Years, are reckoned but one Return.

Mr *Mairan* hopes the learned World will take the whole Performance under their Conſideration, and give their free Thoughts upon it.

The Work conſiſts of 5 Sections; the firſt gives a ſhort Hiſtory of the Zodiacal Light. In the ſecond he treats at large of the Atmoſphere of the Earth; it's Altitude, and the Height of the *Aurora Borealis* in it, and the Excluſion this Circumſtance gives to ſome of the Cauſes, which have been already aſſigned, of this *Phænomenon*. In the third he propoſes the Cauſe, and accounts for the Formation of this Appearance in general, and then deſcends to a Detail of the ſeveral Particulars, adding the Solution of each. The next Section is employed in relating the Hiſtorical Proofs of his Hypotheſis concerning the *Northern Lights*, taken from the Records we have of ſeveral Appearances of thoſe Lights, to be met with in ancient Authors, compared with thoſe of the Zodiacal Light, their ſuppoſed Cauſe, and the Situation of the Earth in her annual Orbit at thoſe times. The laſt Section conſiſts of 28 curious Queſtions concerning ſeveral other *Phænomena* of Nature, which the ingenious Theoriſt believes to have a Dependance upon his new Hypotheſis, and explicable by it.

But a more particular Account of theſe Matters may juſtly be expected.

Mr *Mairan* begins the whole with laying before the Reader a ſhort View of his Hypotheſis concerning the Nature of an *Aurora Borealis*, defining his Terms as he goes along.

The *Aurora Borealis*, ſays he, is a luminous *Phænomenon*, ſo called from the Place of it's Appearance, uſually in the Northern Parts of the Heavens, and with a Light near the Horizon, reſembling that of the Morning Dawn. This Name is ſuppoſed to be firſt given it by Mr *Gaſſendi*, but it appears otherwiſe, from a Place in his Animadverſions on *Diogenes*, quoted by Mr *Mairan*.

The Cauſe of an *Aurora Borealis*, in general, he takes to be a Light called the Zodiacal Light, which is in reality nothing elſe but the Atmoſphere of the Sun ſpread on each Side of him along the Zodiack, in the Form of a Pyramid. This ſometimes is extended to ſuch a Length as to reach beyond the annual Orbit of our Earth, and in theſe Circumſtances ſometimes to blend itſelf with our Atmoſphere, and being of an

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Heterogeneous Nature, produces the ſeveral Appearances which are obſerved in, and uſually compoſe, the *Northern Lights*. This he undertakes to explain, and prove more largely, in the Sequel of the Work.

A Diſcourſe upon the Nature of the *Zodiacal Light*, or Sun's Atmoſpere, and the Matter of which it conſiſts, is the Subject of Chap. 3. That it is very different from the ambient Æther, he ſays is evident, in that the Æther reflects none of the Light of the Sun, is extremely rare, and altogether imperceptible. Whether the *Zodiacal Light* of the Solar Atmoſphere be any Emanation from the Body of the Sun, a Species of Effervescence, or Depuration of it's groſſer Parts, an Amaſs of Heterogeneous Parts diffuſed in the Æther, that meeting from all Parts, tend towards the Sun, *&c.* he will not undertake to determine.

It is enough for his Purpoſe, that it is of a luminous Nature, whether in itſelf, or becauſe ſtrongly illuminated by the Rays of the Sun, whoſe Body it environs. He does not deny but that it may be alſo of an inflammable Nature, nay actual Flame or Fire, though very fine and rare.

He obſerves, that the Form in which the Atmoſphere of the Sun is commonly ſeen in total Eclipſes of the Sun is round, though ſometimes conical, of which he gives us a Figure.

At all other times it moſt uſually preſents itſelf to us in the Form of a lucid Pyramid, or Lance, lying oblique to the Horizon, along the Zodiac, and for that Reaſon called by the late Mr *Caſſini* the *Zodiacal Light*. Mr *J. Childrey* in his Hiſtory of the Natural and Artificial Rarities of *England*, deſcribes it thus: There is another thing which I muſt needs recommend to the Obſervation of Mathematical Men, which is, that in *February*, and for a little before, and a little after that Month, as I have obſerved ſeveral Years together about ſix in the Evening, when the Twilight has almoſt departed the Horizon, you ſhall ſee a plainly diſcoverable Way of the Twilight, ſtriking up towards the *Pleiades*, and ſeeming almoſt to touch them. It is to be obſerved any clear Night, but it is beſt ſeen *illuni Nocte*. There is no ſuch Way to be obſerved at any other Time of the Year, that I can perceive, nor any other Way at that time to be perceived darting up elſewhere; and I believe it has been, and will be, conſtantly viſible at that Time of the Year. But what the Cauſe of it in Nature ſhould be, I cannot yet imagine, but leave it to farther Enquiry.

Upon a farther and cloſer Enquiry, and Conſideration of this Matter, the ingenious Author, Mr *Mairan*, tells us, he takes it to be the Solar Atmoſphere, and therefore treats at large of the Reality, Viſibility, and Antiquity of this Light.

I beg leave to tranſcribe the Accounts of the ſame, given in by the Reverend Dr *Derham*, Canon of *Windſor*. He informs us, that about ¼ of an Hour after Sun-ſet, *April* 3, 1707, he perceived in the Weſtern Parts of the Heavens a long ſlender Pyramidal Appearance, perpendicular to the Horizon. The Baſe of this Pyramid he judged to be the Sun,

Sun then below the Horizon. It's *Apex* reached 15 or 20° above the Horizon: It was throughout of a ruſty red Colour, at firſt pretty vivid and ſtrong, but the Top part much fainter than the Bottom nearer the Horizon. He did not remember he ever ſaw any thing like it, except the white Pyramidal Glade, which is now entitled by the Name of the *Aurora Borealis*, that being like it except in Colour and Length. Again, on the 20th of *March*, 1715-16, in the Evening, he eſpied a very odd Sort of Light in the Conſtellation of *Taurus*. This Glade of Light had the ſame Motion that the Heavens had, and was much like the Tail of a Comet, but pointed at the upper End. This Light, I doubt not, is ſuch as Dr *Childrey* firſt obſerved in *England*, and *Caſſini* and others afterwards in *France*.

Mr *Mairan* proceeds to give an Account of the true Figure, Extent, Situation, *&c.* of this Light, or Atmoſphere of the Sun. It's true Figure he judges, with Mr *Fatio*, to be lenticular, and gives a Projection of it upon the Plane of the Sun's Equator, the Eye being ſuppoſed in the Axis of the Sun produced through his South Pole at ſuch a Diſtance as makes the Solar Atmoſphere appear under the Angle of 45°. In it you have a View of the Nodes, Poles, Limits, Declination, and Extent, paſſing through and beyond the Orbits of *Mercury* and *Venus*, and in ſome Parts beyond the *Orbis Magnus*. This laſt Article of it's Extent he demonſtrates from ſeveral Obſervations of the Elongations of the Apex of this Pyramid from the Centre of the Sun. This has been found to be ſometimes double that of *Venus*, and other times 90° and once or twice above 100, whereas an Elongation of 90° gives the Diſtance of the *Apex* from the Sun equal to that of the Earth at the time of Obſervation.

This Section is cloſed with an account of the Changes, both real and apparent, to which the *Zodiacal Light*, or Solar Atmoſphere is liable. It's Length has been for ſome time upon the Increaſe, afterwards in a diminiſhing Condition, and has been altered ſo much in the Compaſs of 37 Months, as to have been 30° longer at one time than at another. The Changes in Luminouſneſs, Denſity, and Tranſparency, has likewiſe been found to be very conſiderable. Sometimes the *Zodiacal Light* has been ſo rare and weak as to be but juſt viſible, afterwards for a long time not viſible at all.

Hereupon our ingenious Author thinks proper to obſerve, that theſe Conſiderations may ſerve in ſome Meaſure to account for the Inconſtancy of the *Aurora Borealis*, as alſo for their Non-appearance for ſome Years; ſince they owe their Original to, and have ſo cloſe a Connexion with, the *Zodiacal Light*, whoſe Appearance is ſo uncertain. Add to this the *Zodiacal Light*, as he afterwards ſhews, muſt not only be of a ſufficient Length and Denſity, but the Earth muſt be in or near the Nodes, formed by the Interſection of the Plane of the Sun's Equator with the Plane of the Ecliptick.

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The ſecond Section treats at large of the Altitude of our Atmoſphere, and of that of the Region in it uſually poſſeſſed by the *Aurora Borealis*. Under this Head he diſcourſes of the ſeveral Methods the Mathematicians have uſed to find the greateſt Heights of the Air, ſuch as the Duration of the Twilight, the Altitude of the *Mercury* in the Barometer, and rejects them as inſufficient for that Purpoſe; the Atmoſphere being much higher than what has been ever found by them, and conſiſting of a Fluid much finer than the groſs or common Air, the Height of which laſt only is meaſurable by theſe ways.

Mr *Mairan* therefore goes on to ſettle the Altitude of the *Northern Lights*, after another manner, founded upon ſeveral Obſervations made at very diſtant Places at the ſame time, and fixes ſome *Auroræ Boreales* to be but 100 Leagues, though others are no leſs than 300, and the far greater Number of them about 200 Leagues above the Surface of the Earth.

Mr *Cramer*, Profeſſor of the Mathematicks at *Geneva*, computes the Height of the *Aurora Borealis*, ſeen at the ſame time at *Geneva* and *Montpellier*, *Feb.* 15th, 1730, to be $\frac{113}{1000}$ of a Semidiameter of the Earth, *i. e.* about 160 Leagues.

Mr *Meyer* has propoſed in the Memoirs of the Academy of *Peterſburgh*, a very ingenious Method of finding the Height and Diſtance of a *Boreal Arc*, from any Obſerver, by a ſingle Obſervation. Mr *Mairan* applies this Method to ſuch *Auroræ Boreales* as were capable of it, and finds that the *Boreal Arcs* of ſeveral were no leſs than 100 Leagues high.

It is on this account that in the next Chap. our Author conſiders ſome Solutions that have been offered to ſolve theſe Appearances of the *Northern Lights*, and ſets them aſide as inſufficient, becauſe they ſuppoſe Cauſes which have no Exiſtence, or at leaſt no Efficacy at ſo great a Height in the Atmoſphere.

The next Section is the principal, and is engaged in explaining the ſeveral particular Appearances of the *Lumen Boreale*, ſuch as it's Situation, ordinarily towards the N. declining a little towards the W. it's dark, duſky, circular Baſis, ſurmounted ſometimes with one or more luminous Arcs; from behind which Columns, or Streams of Light, ſeem to iſſue either perpendicularly or concentric with the Arcs; add to theſe the Rainbow-Colours, Flaſhes, Vibrations, and in the laſt Place, a Glory, Canopy, or *Corona*, formed by a Concourſe of the Rays of the Matter of this *Phænomenon*, near the Zenith of the Place.

Mr *Mairan* premiſes an Inveſtigation of the *Locus*, or Limit of the Attractive Forces of the Sun and Earth, ſo that a Particle of Matter placed any where in it, will be equally attracted by both, or tend as much towards the Earth as it does towards the Sun. He finds, that if in a Line connecting the Centres of the Sun and Earth, a Point be taken at the Diſtance of about 43 Semidiameters of the Earth from her Centre, that Point will be in this Limit, ſo that a Particle placed there, will not gravitate either towards the Sun or Earth, but remain in *Æquilibrio*,

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the equal and contrary Forces of the Sun and Earth deſtroying each other. The Uſe he makes of this is to ſhew, that an *Aurora Borealis* may poſſibly be formed by a Deſcent of the *Zodiacal Matter*, lying between this Point of *Æquilibrium* and the Earth; though it does not reach ſo far as to involve the Earth itſelf. But the *Aurora* in this Caſe will be an incompleat and particular one.

The *Lumen Boreale* ordinarily appears in the Northern Parts of the Heavens, becauſe tho' the whole Atmoſphere of the Earth be involved in the *Zodiacal Matter* (or Solar Atmoſphere) yet it is thrown off both Ways, from the Equatorial towards the Polar Regions.

This is owing to a double Cauſe, the firſt is the centrifugal Force, ariſing from the diurnal Motion of the Earth, which being greateſt at the Equator (and gradually leſſening as you approach the Poles, where it vaniſhes) makes greateſt Oppoſition there, and not only hinders the Entrance of the *Zodiacal Matter* into the Earth's Atmoſphere, near the Equatorial Region, but turns it aſide into a Courſe towards each Pole; and the Author does not queſtion but an *Aurora Auſtralis* might be ſeen at proper Times in the Southern temperate Zone, juſt as an *Aurora Borealis* is in ours, which is Northern, attended with ſimilar *Phænomena*, were there but attentive Obſervers.

The ſecond Cauſe is the progreſſive Motion of the Earth in it's annual Orbit near one half of the Year with the *North Pole* foremoſt, and in the other half with the *South Pole*, moving through the *Zodiacal Matter*.

The natural Conſequence of which will be a heaping up of Matter, more on the Polar Regions than the Equatorial or Temperate, and this accounts in Part for the Declination of the Centre of the luminous Arcs, ſometimes near 10° from the *Pole*; the Direction of this Motion of the Earth not coinciding with the Direction of the Axis of the Earth at thoſe Times.

The dark arcular Segment next the Horizon appearing like a heavy black Cloud, or Miſt, is formed out of the denſeſt and ſpecifically heavieſt Parts of the *Zodiacal Matter*, which in their Deſcent muſt ſink deepeſt into the Earth's Atmoſphere, and are leaſt inflammable in their Nature, while the rarer and lighter Parts, which are more inflammable and luminous, if not actually inflamed, form the Arc or Arcs that lie above the dark Segment. The ingenious Author ſpeaks of a *Fort de l'incendie*, a Place where the *Zodiacal Matter* collected together, and moving or paſſing through it, is actually turned into Flame. Thus long Trains of deſcending *Zodiacal Matter* arriving in their Deſcent at this Place, being kindled, or at leaſt reflecting the Light of that *Incendium*, produce the ſeveral Columns or Streams of Light that appear above, or behind the obſcure circular Baſe, or luminous Arches.

The Breaks that are ſometimes viſible in theſe Arches, are occaſioned by the Deſcent and Paſſage of ſeveral diſcontinued Trains and Flakes of

of the denſer and leaſt inflammable Parts of the *Zodiacal Matter*, between the Eye of the Spectator and the luminous Arch.

The various Colours ariſe from a Separation of the Rays of Light from each other, either by a Sort of Filtration in paſſing through Mediums of different Denſities, or by the Divergence of the differently refrangible and coloured Rays (or rather from the different Celerities of thoſe Rays, as the Author ſays he has explained more at large in another Place) after the Manner that the Colours are formed in Clouds near the Horizon about the riſing or ſetting Sun.

To conclude, the Canopy in a compleat *Aurora Borealis* he looks upon to be an Object purely optical, a ſimple Appearance ariſing from a ſingular Diſtribution of ſeveral perpendicular Columns, or Trains of *Zodiacal Matter*, as he explains more at large in two Figures. This Exactneſs and Regularity in the Diſtribution makes it an uncommon *Phænomenon*; ſo that among an hundred *Auroræ Boreales* that have been obſerved, he has met with but three attended with a *Corona*.

What remains, is only to take Notice of ſome of the Queries which relate to ſeveral Appearances in Nature, that ſeem to be explicable by our Author's Hypotheſes of a ſolar Atmoſphere, ſuch as the *Nebulæ*, or lucid Spots obſerved among the fixed Stars, the Spots in the Sun, the Atmoſphere and Tails of Comets, *&c.*

The *Nebulæ* are certain luminary Spots or Patches, which diſcover themſelves only by the Teleſcope, and appear to the naked Eye like ſmall fixed Stars. They are ſix in Number, and are accurately deſcribed in *Philoſoph. Tranſact.* N° 347 *. Some of them have no Sign of a Star in the middle of them, and are properly *Nebulæ*, others have, and then are called *Nebuloſæ*. They are looked upon by ſome to be in Reality nothing elſe but the Light coming from an immenſe great Space in the Æther, through which a lucid Medium is diffuſed, that ſhines with it's own proper Luſtre, making a perpetual uninterrupted Day, by no Means owing to the Illumination of a central Body, or Star.

But Mr *Mairan* ſeems to be of another Mind, and queries thus: Since the fixed Stars are Bodies of the ſame Nature with our Sun, may not ſome of them have Atmoſpheres ſurrounding them ſo luminary and extending, as to become viſible to us by a Light eaſily diſtinguiſhable from that of the central Body, and may not Atmoſpheres of others be ſo denſe as well as luminous, and extended, as may ſuffice to obſcure (to uſe the Author's Expreſſion) the Light of the Star involved in it? Are not the *Nebuloſæ* of the former Sort, and the *Nebulæ* of the latter? The lucid Spot in *Cingulo Andromedæ*, which, after *Hevelius*, our Author continues to call a *Nebuloſa*, has been found by the late Mr. *Caſſini* to reſemble the *Zodiacal Light* in ſome Circumſtances, and by Mr *Kirch* to have ſuffered ſome Changes appearing and diſappearing by Turns.

* See Vol. IV. Chap. III. §. vii.

Mr *Mairan* obſerves by the Way, that this Spot was firſt diſcovered, not by Mr *Bullialdus* in 1660, as is commonly believed, but by Mr *Simon Marius* in 1612, who fully deſcribes it in the Preface to his *Mundus Jovialis*.

The luminous Space round the *Nebuloſæ* of *Orion's Sword*, diſcovered and deſcribed by Mr *Huygens*, he takes to be an Aſſemblage, or Sum total of the ſeveral Atmoſpheres of the Stars, plainly viſible within that Space, and it may be of ſome others that are concealed from our View. The Irregularity of the Shape is no Difficulty to him, it ariſing from the different, and to us ſeemingly irregular, Poſitions of their Atmoſpheres. He adds, as a Confirmation of his Hypotheſis, that the Brightneſs and very Figure of this Space has ſuffered ſome Alterations ſince Mr *Huygens*'s Time. That one of the Stars delineated by Mr *Huygens* without any ſurrounding Light, has ſince been found to have a pale Light like an Atmoſphere ſurrounding it.

Query 2. Is not the ſolar Atmoſphere liable to frequent Fermentations, and ſubſequent Precipitations of it's groſſer Parts towards the Surface of the Sun? And are not the different Degrees of Brightneſs and Tranſparency owing hereunto? ſince the Changes in our Air, or Atmoſphere, are not ſufficient to account for the Non-appearance of the *Zodiacal Light* in ſome convenient Seaſons, and clear Nights.

Query 3. May not the Spots, ſo often of late obſerved in the Surface of the Sun, be owing to theſe Precipitations of the groſſer Parts of the *Zodiacal Light*, ſince there ſeems to be ſome Analogy or Correſpondence between the Frequency, Ceſſation, and Returns of theſe Spots, with the Ceſſation, Returns, and Apparitions of the *Zodiacal Light?*

Query 4. Are not the inferior Planets, *Mercury* and *Venus*, almoſt always immerſed in the *Zodiacal Matter?* And may not that be one Reaſon why it is ſo difficult to obſerve Spots in them? May not a Change, the Denſity, or Magnitude of the ſolar Atmoſphere, be one Reaſon why the Aſtronomers at *Paris* have not been able to obſerve thoſe Spots in the Diſk of *Venus* that have been taken Notice of, and deſcribed by Mr *Bianchini* at *Rome*, a little before, ſince the Teleſcopes at *Paris* were of equal Length and Goodneſs?

Query 20. May not the Augmentation of the Quantity of Matter in the Earth and inferior Planets, by the continued Accumulation of the *Zodiacal Matter* on their Surfaces during a long Courſe of ſeveral Ages, produce, among other Things, ſome Alteration in their periodical Motions?

Query 21, *&c.* May not the Atmoſphere and Tail of a Comet be owing to the *Zodiacal Matter*, which the Comet, during it's Paſſage through

through the Atmosphere of the Sun, intercepts, and afterwards carries away with it in it's Ascent from the Sun?

Query 28. Is not the Earth safe enough from all Danger of any Inundation, much more of an universal Deluge, tho' it should pass through the Atmosphere, or Tail of a Comet? since the Effects of such a Passage can only be an *Aurora Borealis*, whose Matter is not at all of a watery vaporous Nature? A Conflagration rather than an Inundation might have been imagined to be the natural Consequence, but Experience informs us, that if this Hypothesis be admitted as genuine, that our Earth has been entirely plunged in this *Zodiacal Matter* without any sensible Heat attending it.

A Description of the Northern Lights seen at Wittemberg, *in* 1732, *by* Jo. Fred. Weidler, *L. L. D. P. P. Math. and F. R. S.* No. 432. p. 291. Apr. *&c.* 1734.

XLVIII. *Feb.* 18, 1732, *O. S.* about 9 at Night, the Sky being clear, there was an *Aurora Borealis*. In the N. there was a dark Arch elevated 20° in it's middle Part, whereas a little before the Sky had been observed to be very clear in the same Part. The Region over this dark Arch was white, and Radiations or luminous Pyramids broke out of it as usual, and thin white Vapours ran swiftly toward the *Vertex*, like little Clouds.

At 10 the Motion of the luminous Matter seemed to cease a little; and presently white Vapours like Waves proceeded again from that white Region of the Heavens: But there was no Resemblance of a Canopy seen toward the *Vertex*.

At $10^h\ 30'$, the white Border of the dark Arch was extended; but only a few lucid Vapours proceeded from it. Lucid Pyramids arose on both Sides near the N. Pole: But the fluctuating Vapours were more frequent toward the W. The Air was continually calm.

Oct. 12, 1732, *O. S.* presently after 6 in the Evening there was another *Aurora Borealis*. A dark Arch was extended between N N W and N E. Above it there was a bright Region of the Heavens, about 10° broad, not exactly expressing the Figure of an Arch. A broader Portion declined about 10° from the N. Pole to the W, and from this, as from a Fountain of lucid Matter, at $6^h\ 30'$ there went several white Pyramids, which reached almost to the Zenith. Some of them were reddish, and presently disappeared, one of them, which was extended between the Northern Crown and *Hercules* to the Zenith, lasted longer; and I observed but one Radiation only toward the N E. Within a Quarter of an Hour the Appearance was over. The Clouds, which before hung about the W, were dispersed by a S W Wind, and driven toward the E. But under them, toward the E, there remained a lucid Region, and the dark Arch was hidden below the Horizon, the white Arch, which lay over the dark one, descended below the Horizon with the Clouds, and the Darkness and thin Clouds being dispersed, there was an universal Brightness at 7^h: But a thin Light possessed the N. Part of the Horizon all Night long.

Beſides theſe Obſervations, which I made myſelf, other Northern Lights are ſaid to have appeared, tho' leſs bright, on *March* 10, *Apr.* 11, *Aug.* 11, and 30, *O. S.* but I have no certain Knowledge of the particular *Phænomena* of them. But from theſe and other Obſervations, which I have made in former Years of that Light, I am more and more perſuaded that it has it's Seat entirely about the magnetical Pole, or at leaſt that it's Motion is thereby in ſome Meaſure ruled and determined, which was firſt of all apprehended by the great Sagacity of the illuſtrious *Halley*.

We have not yet any certain Knowledge of the Effects of the *Aurora Borealis*. I have only obſerved, that ſome ſerene Days have always followed that Deflagration. The *Suedes* and *Norwegians*, to whom this *Phænomenon* more frequently appears, are ſaid to have learnt from long Experience, that the Northern Light, when it ſhines frequently about the Beginning of Autumn, promiſes a more temperate Air, and plentiful Harveſt, for which Reaſon they call the *Aurora Borealis*, Kornmod, or *ripening of Corn*. They alſo look upon the frequent Returns of them in Winter as a Token or Preſage of a ſharper Cold, as M. *Leopold* relates in his Letter to Dr *Woodward*. The Experiments made in our Climate in 1731 agree with this *Hypotheſis*; for the Northern Light was very frequent and bright in that Year on *Oct.* 4, 7, 8, 10, and 23, S. N. and was followed by ſo fruitful a Seaſon, that we had a great Plenty both from the Fields and Gardens in 1732.

Obſervations of the Aurora Borealis *made in* England, *by* Andr. Celſius, *F. R. S. and Sec. R. S. of* Upſal *in* Sweden. No. 441. p. 241. Apr. &c. 1736.

XLIX. *Sept.* 13, 1735, at *Woodford*, 6 Miles to the N E of *London*, at 11 $\frac{1}{2}^{h}$ at Night, there appeared a bright Band, almoſt parallel to the Horizon; and it's Middle was judged to be under η of the Great Bear. At Times another Light ſhot along the Great Bear; but almoſt conſtantly covered the Stars γ and δ.

Octob. 4, in *King-ſtreet, Bloomſbury.*

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At	9	22	0	*p. m.* A Ray or Stream of Light appeared under the Polar Star perpendicular to the Horizon.
	9	24	13	That Ray diſappeared.
	9	27	6	Two perpendicular Rays ſhot forth 5 or 6° from the N. towards the E.
	9	28	30	A whitiſh Ray again exactly under the Polar Star.
	9	30	0	That Ray moved Weſtward.
	9	31	0	'Twas ſeen under η of the Great Bear.
	9	31	27	It entirely diſappeared.
	9	36	8	A Ray aſcending perpendicularly by the Polar Star, and α and β of the Great Bear.
	9	40	0	The Ray ſeemed to move gradually under ξ of the Great Bear.
	9	44	0	No more Rays appeared. But whether there were any Remains of Light near the Horizon, or in the Weſt, I could

I could not see, upon account of the neighbouring Houses.

Octob. 11, in *London.*

	h	′	
At	10	37	*p. m.* There were two bright Rays under ζ and ε of the Great Bear.
	10	39	A Ray between ε of the Great Bear and the Polar Star.
	10	39½	A Ray in Form of a Pyramid above η of the Great Bear.
	10	43	These Rays had not any Motion parallel to the Horizon; but they entirely disappeared.

Jan. 11, 173$\frac{5}{6}$, in *London.*

At	10	0	*p. m.* An indifferently bright Arch, pale towards the Edges, appeared 16 Degrees high: One of the Ends of which descended Eastward under η of the Great Bear: And lucid Streaks appeared now and then over this Arch.
	11	13	Under this Arch was another very bright Track parallel to it, 5° above the Horizon; in which Track there were Rays, that shot from W towards the E.
	11	15	This Arch was very faint.
	11	17	The first Arch became brighter, and the lower Arch was almost blended with the upper, and broken in the middle.
	11	20	The whole Arch was beset with faint Rays.
	11	21	One of the Rays under the Polar Star.
	11	27	No Arch, nor Rays, but bright Tracks dispersed here and there.
	11	36	The Light reached up to the Polar Star, and somewhat higher.
	11	44	A lucid Ray under the Polar Star.
	12	11	The Sky was overcast with Clouds, except one lucid Streak, which appeared three or four Degrees to the East of the North.

February 16, in *Clare-Hall, Cambridge.*

At a Quarter past eight in the Evening, the Moon shining very bright, there appeared two perpendicular Streams betweeen the great and little Bear.

April 3, in *London.*

At	8	46	I observed a lucid Arch one Degree broad, which extended along the Northern Crown, the *Cingulum Bootis*,

tis, the *Coma Berenices*, the leſſer Lion and Cancer, as far as the ſmaller Dog.

h	′	″	
At 8	49	36	This Arch quite diſappeared: But at the ſame Time I ſaw another broader and brighter Arch under *Caſſiopea*, ſeven or eight Degrees high.

In the Obſervations of *Oct.* 4, and in the laſt, I am certain as to the Time of the Clock: So that if it has happened that others have obſerved the ſame *Phænomena*, the Longitudes of Places may be determined by them with greater Exactneſs than by the Satellites of *Jupiter*, which I take to be the principal Uſe that may be made of theſe Obſervations, eſpecially in making Maps of the Northern Countries, where theſe Lights more frequently occur.

Auroræ Boreales *obſerved at* Wittemberg *in* 1733, *by* J. Fred. Weidler, *Prof. Math. &c.* Ibid. p. 238.

L. *May* 3, 1733, an *Aurora Borealis* is ſaid to have appeared.

June 26, an *Aurora Borealis* appeared in the Evening, and darted out the uſual Pyramids about Midnight.

Oct. 27, about 7^h in the Evening a dark Arch appeared in the N, covered with a white Border. At 8^h $30'$ the white Border was expanded higher to the Height of about 40°, and this lucid Region remained ſtill to paſt 10. After 10 pyramidal Eradiations darted with great Quickneſs from the white Track, and ſome waving Clouds moved along the Sky, and the whole white Border was ſeen to riſe toward the Pole, like a lucid Wave. This Undulation of ſhining Matter, with ſome pyramidal Rays mixt here and there, much more bright than that lucid Region, laſted till 11, the whole lucid Matter was gradually moved toward the E, and in it's Place ſome black, ſcattered Clouds ſucceeded toward the W. A little before 11, near the N W, there remained a white Cloud, which ſometimes grew red, and the Matter of it alſo waved. The Appearance ceaſed after 11: The Air was calm during the Appearance, and the Stars ſhone through the white Region. I thought it remarkable, that the Sky was dark and rainy the next Day, and that in the Night after the 29th, the Wind was very impetuous and ſtormy, whereas calm Weather commonly follows remarkable *Auroræ Boreales*.

The ſame *Phænomenon* was obſerved alſo at *Stockholm*.

——*In* 1734, *by the ſame.* No. 442. p. 266. July, *&c.* 1736.

LI. *Jan.* 23, 1734, a very bright *Aurora Borealis* appeared at 7^h $6'$, *p. m.* Under the N. was ſeen a dark Arch, with a double white Border over it, ſeparated by a dark Region in the middle. The laſt white Arch aroſe to the Height of 25°. In the dark Part ſome lucid Pyramids now and then ſhot forth; and a ſimilar white Arch was produced by the Light reflected near the Zenith. At 7^h $30'$ the white Track was diffuſed further to the W, and in the middle reached to the Height of 50°. At 7^h $35'$ the bright Region was drawn up quite to the *Vertex*; ſome intermitting Clouds tended toward the W, which very ſeldom

happens

happens in an *Aurora Borealis*. I wondered alſo at ſome Clouds that hung about the N E, and moved before the lucid Region, the Light of the *Aurora* being diſtinctly ſeen beyond them; whence it appears, that this Light is far above the Clouds. At 7^h $38'$ the lucid Region of the *Aurora* ſunk below the Horizon, eſpecially toward the W; and it is worthy of Obſervation, that tho' this *Aurora* was very bright, it ſhewed but very few lucid Pyramids. At 8^h $30'$ almoſt the whole Light was hid below the Horizon, but appeared near the W. to the Height of 10^o. A Track of the dark Arch under the Pole, with a ſmall white Border over it, was yet viſible at 10^h.

March 19, 6^h $45'$, *p. m.* about the N N W there appeared under the Pole a dark Arch, covered with a broad white Border; the Light of the white Border was brighter toward the W, than toward the E, but was not followed by lucid Pyramids or Waves, ſuch as uſe to accompany the *Aurora Borealis*: Therefore there are ſome *Auroræ Borealeſ*, which diſcover only a white Region in the North, but without any Motion of Light.

March 29, there was a remarkable *Aurora Borealis*, which I did not ſee till 9. The Moon was then near ſetting, and ſhone only through Clouds: The whole Sky was almoſt covered with Clouds, and yet about the Pole there was a bright Region behind the ſcattered Clouds, from which ſome lucid Pyramids now and then proceeded, a ſure Mark of an *Aurora Borealis*. I perceived alſo behind the Clouds a lucid Track of an *Aurora*, that was formed into an Arch. The lucid Pyramids continued till 11; a rare Spectacle in a cloudy Sky, agitated by Winds; for the *Aurora Borealis* is ſeldom ſeen but in very calm, ſtill Weather.

Aug. 9, at 11^h ſome thin Clouds about the N N E ſeemed to burn. But a few Radiations being emitted toward the *Vertex*, the Inflammation ceaſed, and the little Clouds were driven toward the Eaſt by a gentle Wind.

From theſe and other Obſervations we may plainly perceive how variable a *Phænomenon* is the Light of the *Aurora Borealis*.

LII. *Dec.* 11, 1735, a little after five o'Clock, I obſerved the Northern Hemiſphere to be obſcured by a duſky red Vapour, in which, by Degrees, appeared ſeveral very ſmall black Clouds near the Horizon. I thought it ſeemed to be a Preparation for thoſe Lights which afterwards were ſeen; the firſt Eruption of which was within a Quarter of an Hour, full E, from behind one of the ſmall dark Clouds, and ſoon after ſeveral others full N. Theſe Streams of Light were of the ſame duſky red Colour as the Vapour, juſt appeared, and vaniſhed inſtantly. I ſaw 8 or 10 of theſe at once, about the Breadth of the Rainbow, of different Heights, ſeveral Degrees above the Horizon, and looked like ſo many red Pillars in the Air; and no ſooner did they diſappear, but others ſhewed themſelves in different Places. In about half an Hour, this Colour of the Vapour gradually changed itſelf towards the uſual White,

An Aurora Borealis *obſerved at* Peterborough, Dec. 11, 1735, *by Mr* Timothy Neve. No. 445. p. 53. Jan. *&c.* 1737.

White, and ſpread itſelf much wider and higher; and after that, appeared as common.

——*At* Edinburgh, *by Mr* James Short, *of the College at* Edinburgh. No. 456. p. 368. Jan. &c. 1740.

LIII. I came here on *Sat.* laſt: That Evening, about 6, there was one of the moſt remarkable *Auroræ Boreales* that ever I ſaw. At firſt there appeared the ordinary luminous Arch, the Vertex of which was about 30° above the Horizon, and had it's Centre ſomewhere in the Meridian Circle. After this was perfectly well formed, there appeared little or none of the purple and red Colours which are uſually in that Arch; but immediately there broke out, from the moſt Weſtern Extremity, a great deal of that Northern Light which formed this Arch, and, ruſhing along with Rays directed to the *Zenith*, formed another *Aurora Borealis* above the firſt, the Centre of which was to the Eaſt of the Meridian: After this was formed, there followed from the ſame Extremity a great deal of purple and red-coloured Light, quivering and ſhaking towards the *Zenith*, with a flapping Noiſe in ruſhing along, till it formed a third *Aurora Borealis*, above the ſecond, the Centre of which was ſomewhere on the Eaſt-ſide of the Meridian. When I was pleaſing myſelf with this remarkable *Phænomenon*, looking again to the Weſtern Source of theſe Arches, I perceived, as it were, a huge Pillar of a dull red coloured Light, riſing out of the ſame Place whence the Arches took their Beginning, extending itſelf in a Direction towards the *Zenith*, till it roſe almoſt 60° high. Theſe Arches and Pillar laſted very near an Hour; the two uppermoſt Arches were continually quivering and ſhaking, and the Pillar always turning to a paler Red.

I forgot to tell you, that the Night before the *Aurora Borealis*, there was a prodigious Hurricane of Wind, which laſted till the *Saturday* Morning; but all that Day it continued to blow, though not ſo hard. The Arch from whence the Wind blew, was from the N W, the ſame Quarter from whence the Arches took their Riſe. To this Day, ever ſince the Hurrican of Wind, there has been a moſt intenſe Froſt: It froze ſo hard, that in leſs than 24 Hours after it began, the Lake on the North-ſide of this City was ſo ſtrong as to bear People on it. Juſt now the Wind has changed, ſo that we expect a Thaw.

An Aurora Auſtralis, *ſeen* March 18, 1738-9, *at* Chelſey, *near* London, *by* John Martyn, *F. R. S.* Prof. Botan. Cantab. No. 461. p. 841. Aug. &c. 1741.

LIV. 1. *March* 18, 1738-9, at $8^h\ 30'$, being informed, that there was a great Fire towards *London*, I made Haſte towards an upper Window that looked to the N N E: I found an extraordinary Redneſs in the Air, but of too determined a Figure to ariſe from the burning of a Houſe: A broad red Band extended itſelf to the Northward of the E; in the middle of which I very plainly ſaw *Arcturus*, then about 25° high; and it's Northern Edge touched *Cor Caroli*. It ſeemed to be fixed and permanent; not radiating, or fading, as in a common *Aurora Borealis*. This red Band, or Arch, was bounded on the N. by Streams of a greeniſh Blue, in the ſame Direction; the moſt Northern Edge of of which touched the Star marked η in the Tip of the Tail of *Urſa Major*. After I had conſidered this Phænomenon for ſome little Time, I retired into my Garden, where I ſaw a great Brightneſs almoſt in the Zenith,

Zenith, but declining to the S W; which I found to be a Centre, from which many luminous *Radii*, of which the red Band was much the moſt conſiderable, proceeded. This Crown, or Centre, ſeemed, at that time, as near as I could judge, about the Place of *Cancer*; for it effaced all the neighbouring Stars, and I could but juſt ſee two Stars, which I take to be thoſe in the Heads of the *Twins*; when the Brightneſs was moſt faded: It would ſometimes almoſt diſappear for near a Minute, and then kindle again, and dart Rays on all Sides; but thoſe to the W. and N. were ſhort, pale, and ſoon diſappeared. Thoſe which ſhot Southward, were of a fiery Red; and the whole Southern Part of the Atmoſphere was tinged with a red Brightneſs, which did not however reach quite down to the Horizon; for, to the S W, where my Proſpect was leaſt confined, I could ſee *Sirius*, then about 15° high beyond the red Light. The Houſes oppoſite to mine hindered me from ſeeing, how far to the E. and N E the red and blue Rays extended. All this while, the N. and N W Parts of the Heavens ſeemed dark, by Reaſon of the great Brightneſs in the E. and S: It was very clear however, and the Stars viſible. About 9, the red Band had covered the Tail of *Urſa Major*, having moved conſiderably towards the N, the Centre continuing in the ſame Place; and by degrees it faded ſo as not to be diſtinguiſhable from the common Redneſs which was ſpread over ſo conſiderable a Part of the Heavens. About 10 I went to the Riverſide, where I had a large Proſpect to the S E; and found all that Part covered with a duſky Red, quite down to the Horizon. There were afterwards ſome faint Rays darted, ſometimes from the Centre of this Phænomenon, which has the Appearance of a common *Aurora Borealis*.

2. About $7^{h}\ 30'$ the Sky to the N. was very clear, and the Stars ſhone bright; to the S and S E, as I was in the Skirt of the Town on the N W Side, the Sky looked obſcured, partly from a Miſt, partly from the Smoak of the City. At the ſame Time there appeared a bright Column ariſing ſomewhat N. of the E, or about the E N E, which reached up with it's Point near to the *Zenith*, but going a little South of it. This Column ſeemed to be the Boundary of the clear and obſcure Regions of the Sky above mentioned: It had an uniform ſteady Light, without any Dartings or Shiverings; but it ſometimes vaniſhed for a few Minutes, and then returned again all at once, not proceeding from the Bottom, but from the Side next the miſty Part of the Sky, as if it were only the Border of the Miſt illuminated. About 8 this Column was grown much wider, and all of a Breadth, extending in the ſame Direction beyond the *Zenith* to the W S W, as far as I could ſee for the Houſes; the Addition to it's Breadth ſeemed to be all on the Southern Edge of it; this whole Band was of a moſt beautiful Pink-colour. At $8^{h}\ 15'$ the *Phænomena* remained the ſame; but to the N N W there appeared ſome whitiſh Clouds about 20° from the *Zenith*: Out of theſe aroſe three beautiful Pyramids of Light, which extended

— *at* London, *by* Cromwell Mortimer, *M. D. Secr. to the* Royal Society. *Ibid.* p. 839.

very near the *Zenith*; the middle of theſe Pyramids were of a beautiful Sea-green, which went off gradually in lighter Shades towards the Edges, which were of a bright White; the Colour of theſe very much reſembled the Light of *Phoſphorus*. I obſerved theſe Columns for ſome Minutes, and then, going in a-doors, ſaw no more of the *Phænomenon*; and was told, half an Hour after, that it was all over; but have been informed ſince, that it returned again about ten; when the Redneſs ſpread, almoſt univerſally, over the Southern Parts of the Heavens.

——*at* Peterborough *by the Rev. Mr* Timothy Neve, *Ibid.* p. 843.

3. About 7^h 30′, till almoſt 9, it ſpread with Variety of Colours all over the Horizon, meeting in a Centre almoſt vertical, but ſomewhat inclining to the S. The original Colours were ſo mixed and blended in the common Centre, as by the vaſt Variety eaſily diſtinguiſhed, made a beautiful Appearance. The fainter Colours came from the 2 oppoſite Points of the N W and S E: The Blood-red Crimſon, *&c.* were ſeen chiefly in the N E and S W. The Wind, I think, full N, but very ſtill. The 3 preceding Days were exceſſive cold; the Barometer fell 8 or 9 Degrees, and we had very great Quantities of Snow, Hail, and Rain, moſt of that Time; and, if I remember right, the Lights in the Air, of late Years, appear after ſuch Storms, eſpecially for 10 Years paſt, when our Winters have been unſeaſonably mild, and our Summers cold and rainy.

——*at* Rome Jan. 27. 1740, *by the Abbot* Didacus de Revillas *F.R.S.* No. 460. p. 744. Apr. *&c.* 1741. Fig. 41.

LV. The Sky being all over cloudy, and a ſtrong S. Wind blowing, at 6^h *p. m.* a reddiſh Light appeared between 45 and 55° of S E Amplitude. The greateſt Breadth of it above the Horizon was about 9°. But in a Part of the Sky neareſt to the Horizon, darkened to about 1°, there was a Space of Light, almoſt of the Figure of a Parallelogram, about 10° broad, and 8° high; which ſhone more in the upper Part than in the lower. Among the thicker Clouds there was one extremely black, A B, almoſt parallel to the Horizon, extended above the Light toward the S.

In about ½ an Hour the Light became more vivid, and then ſenſibly diminiſhed again; which it did ſeveral Times till 9^h. In the meantime a little thin Cloud, C D, parallel alſo to the Horizon, appeared interſecting the Light on the Southern Side. About 9^h other Clouds, proceeding from the E. toward the S. covered the Light, which was then fading, and about 9^h 30′ extinguiſhed it entirely. After 12 there fell a great Shower.

The Barometer all this time ſtood at the Height of 27.9¼ *Paris* Inches. The mercurial Thermometer, which in boiling Water is at 0°, and in Snow mixed with ⅖ of common Salt is at 180, was then at 141 Degrees.

The ſame Light was obſerved more bright and diſtinct, at the ſame Time, by ſome who were coming from *Viterbo* to *Rome*, and by others in the *Via Valeria*, 25 Miles to the Eaſtward of the City.

LVI. 1. PART II. Containing Meteorological Obſervations made at

Peterſburgh, *Lunden* in *Sweden*, } 1724, 1725. | *Lunden in Sweden*, } 1724.

A Journal of Meteorological Obſervations *made at* Peterſburgh, *By the Rev. Mr* Tho. Conſett, *from* Nov. 24, 1724, *to* June 23, 1725, *abſtracted for the Uſe of the* Royal Society. *By* W. Derham, *F. R. S.*

An Abſtract of the Meteorological Diaries, communicated to the Royal Society, *with Remarks upon them. By* W. Derham, *D.D. Canon of* Windſor, *and F. R. S.* No. 429. p. 101. July &c. 1733.

This Journal contains Obſervations, 3 times in the Day, of the Barometer, the Winds and their Strength, the Weather, and (after *April* 15) of the Thermometer. Which Obſervations (although very curious and uſeful) yet being too long, would be tedious to be read at the Societies Meetings; I therefore deſire the following Extract may be acceptable.

Mr *Conſett*, from the beginning noteth down the Barometrical Variations, but I know not his Diviſions, and Degrees, 'till *Dec.* 18, at 3^h *p. m.* and then the Barometer was at 30 66 Wind N E^1 and fair.

From *Nov.* 24 to the End of the Month, the Weather was cloudy, with Snow, and a deep Snow on the laſt Day, and fair on the 28th. The Winds were E. and N E of 2 and 3 Degrees Strength, 'till the 29th and 30th, and then SE^3 S^4 and SW^3.

In *Dec.* it was cloudy, with ſome Snow, 'till *Dec.* 8, and 9, which were fair Days. Then cloudy on the 10th and 11th, and Rain in the Evening. Afterwards ſome cloudy and moiſt Air; ſome fair, 'till *Dec.* 23, and then Hail; Wind SW^3. The next Day Snow; and the reſt of the Month ſome cloudy and dark, with Snow, and ſome fair. The Barometer, ever ſince the 18th, hath been above 30 Inches, and on *Dec.* 26, it was 30.84; on *Dec.* 30, 30.96, and 31.00; and laſtly on *Dec.* 31, it was 31.12.

In *Jan.* 1724-5, on the 3d Day, the Barometer was at 30.65, on the 4th before Noon 31.32, after Noon 31.36, but on the 5th it was in the Afternoon 31.59, the Wind SW^1 and cloudy Weather, which is the higheſt Range of the Quick-ſilver in all the Obſervations, and if I miſtake not, the higheſt I ever met with any where, and at any time. On the other Hand, the loweſt Range was on *February* 25, at 28.28; Wind W^4 and Snow. The Barometer was above 30 Inches all the Beginning of *Jan.* 'till the 18th, and then it gradually fell to 28.36. The Winds, for the moſt part, were in ſome Weſterly Point 'till *Jan.* 11, and then SE^2 with fair, and an hard Froſt for a Week; the Weather, before the 11th, being cloudy and moiſt, with ſome Snow now and then, and a little Rain on *Jan.* 1. All the reſt of *Jan.* was, for the moſt part, cloudy with Snow, and but little fair, and that attended with Froſt.

In *Feb.* the Barometer continued high, until, by a gradual Deſcent, it came to 28.98, on *Feb.* 15, and 17; Wind Weſterly 3. and 4. But on *Feb.* 25, it fell to 28.28; Wind W4, and is abovementioned. The greateſt Part of this Month the Weather was cloudy, and ſometimes with thick Darkneſs, frequent Snow, and now and then fair, with ſharp Froſt.

All *March* the Barometer was above 29 Inches, ſometimes above 30. The greateſt Part of the Month was cloudy, with frequent Snow, and ſome fair, with ſharp Froſts; the Winds were variable, and their Strength about 1 and 2 Degrees all the Month, and ſeldom at 3 Degrees, nor calm at any time.

All *April* the Barometer was above 29 Inches, and under 30. In the Beginning of the Month Snow and cloudy, with ſome fair, and ſharp Froſts, 'till *April* 13; when Mr *Conſett* ſaith, the continual Winter-Froſts were thawed; and that on the 15th they left off their Fires in their Stoves. After this, ſome cloudy, ſome Rain, and ſome fair; the Winds were variable, commonly 1 and 2 Strength, now and then 3, and not any Day 0.

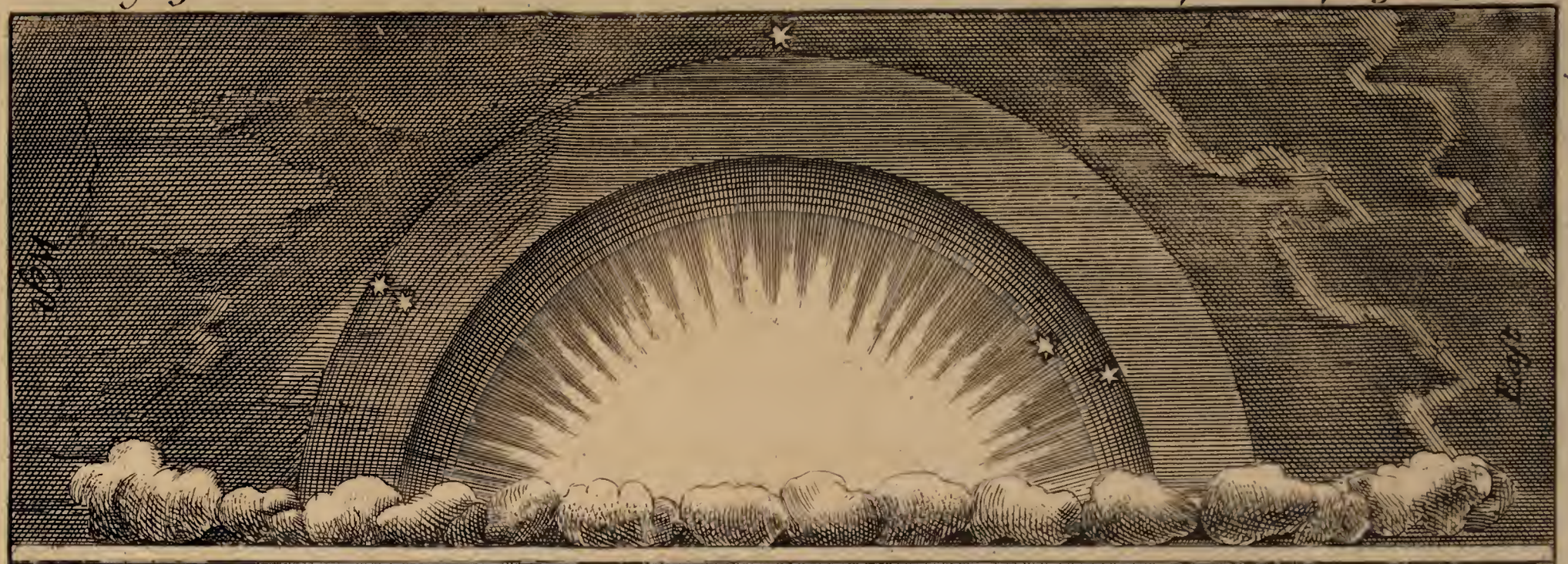
From *April* 16, he obſerved the Thermometer; which being one made by Mr *Haukſbee* ſtood at 51, which is between cold Air, and temperate; the freezing Point being at 65; it then roſe for ſome Days to 46, and 40, 'till on the 22d it was at 36, and towards the End of the Month it fell again to 47.

All *May* the Range of the Barometer was between 28 and 29 Inches; and for the moſt part above 29 50. The Thermometer was on the 1ſt Day at 52.8, and continued riſing to 50 on the 7th, where it ſtood to about the 14th, and then aroſe to 40 for the following Days, being at 40.25 on the 17th in the Morning, Wind S2. and fair, when in the Evening of the ſame Day it aroſe to 30.34, Wind W2. with Rain; it ſoon got down again to 40 for ſeveral Days; but from the 27th to the End it was about 30.50. This Month had much more fair than any of the preceding Months, together with ſome cloudy with Showers, and ſome heavier Rain.

In *June* the Range of the Barometer was (as in the laſt Month) between 28 and 29 Inches, but more frequently under 29.50 than it was in that Month. The Thermometer was all this Month between 40 and 41, only on the 1ſt, 2d, 3d, 8th, 11th, 13th, 23d Days, it was a little above 31, but never ſo high as 30, which is between warm Air, and Hot. On *June* 2, Rain fell with Hail. And (as I have obſerved in ſome of theſe Papers) that *Cold in Summer produces Rain*, ſo much Rain fell on *June* 5; after which, ſome cloudy, with frequent Showers, and many Days fair, to *June* 23, on which the Obſervations end.

Thus I have given an Abſtract of the *Meteorological Obſervations* at *Peterſburgh*, and have taken what Care I could to note ſuch Matters as may give the Society a juſt Notion of the State of every Month at that Place,

Fig. 38.



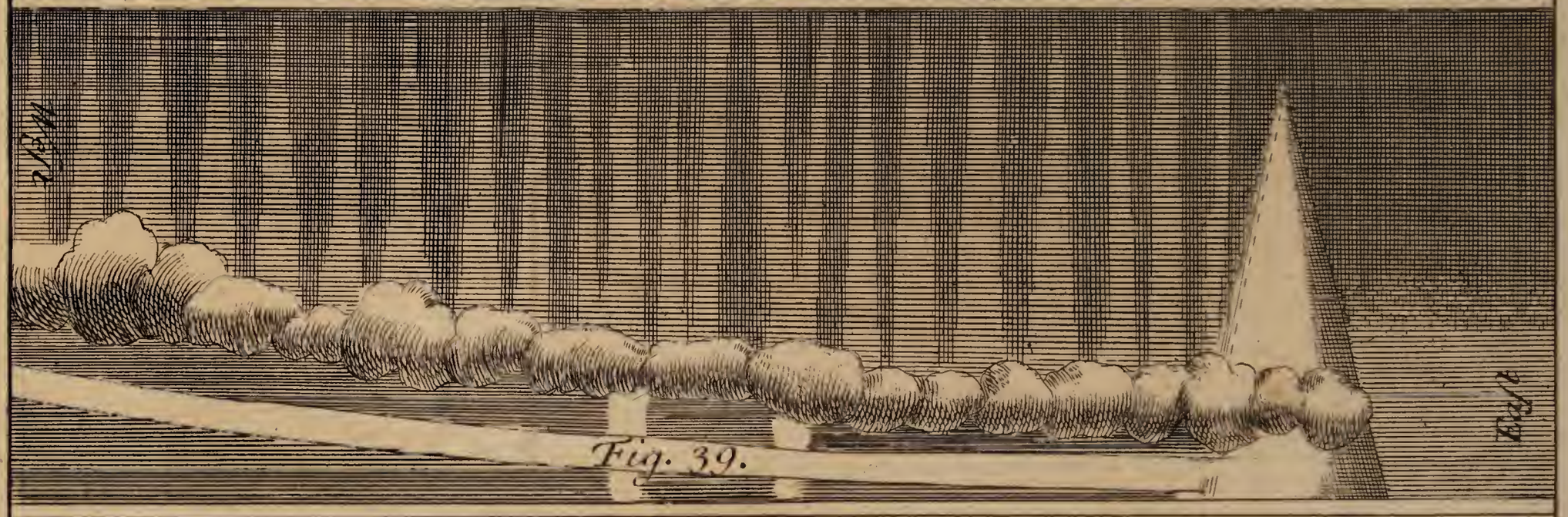


Fig. 39.

Fig. 40.

Place, and that which was moſt obſervable in it. I could wiſh, that either the Society, or I myſelf could have had ſome Obſervations in the more Southerly Parts, to have tallied with theſe.

Appendix to the foregoing Obſervations, being Meteorological Obſervations at Lunden *in* Sweden, *in the Year* 1724, *which tally with Mr* Conſett's.

Theſe Obſervations not coming to Hand 'till I had finiſhed thoſe at *Peterſburgh*, I am forced to ſubjoin them by way of Appendix; and the 1ſt Obſervation I ſhall make, ſhall be of the Range of the *Mercury* in the *Barometer*, which ſeems to be different in both Places, as far as I can judge of the Matter, by the few Obſervations that tally with one another, which is only from *Dec.* 18, to the End of that Month, Mr *Conſett*'s Barometrical Diviſions before that time not being intelligible: And in all that Fortnight's time, the *Peterſburgh* Barometer was above 30 Inches, and once above 31; whereas that at *Lunden* was but a little above 29, and but once at 29.6: And indeed, through the whole Year, the *Lunden* Barometer, I obſerve, was only now and then below 29 Inches, and much ſeldomer above 30. But I ſhall perhaps be better able to give an Account of theſe Matters when I come to the Obſervations of future Years.

2. As I have taken Notice in other Places, ſo I find in theſe Obſervations a great Conformity between the Winds, eſpecially when ſtrong for ſome time, and when they have been for ſome time in or near the ſame Quarter.

3. As for the *Weather*, no good Judgment could be made of it in the Space of five Weeks, which is all the time in which the Obſervations tally: Only I take Notice that Thunder was more frequent at *Lunden* than *Peterſburgh* during that time.

An Abſtract of the Meteorological Obſervations of the whole Year 1724, *made at* Lunden *in* Sweden. *By* ———. *Abridged for the Uſe of the* Royal Society. *By* W. Derham, *F. R. S.*

Having taken Notice of the Obſervations in 1724, that tally, I proceed to the whole Year's Obſervations of *Lunden*.

I begin with the *Barometrical Ranges*, which will be beſt ſeen and compared by theſe two little Tables; the firſt of which is, in part, the curious Author's, *viz.* the mean Heights of the *Mercury*; to which I have added the higheſt and loweſt Ranges in each Month. And becauſe it will take up but little Room, I have added the Author's Mean of his Thermometrical Obſervations, although, I confeſs, I ſcarce underſtand the Diviſions of his Thermometer.

The Higheſt and Loweſt Ranges of the Barometer, and the Mean of the Barometer and Thermometer at *Lunden*, in the Year 1724.

	Jan.	*Feb.*	*March*	*April*	*May*	*June*
High	29. 8	29. 9	30. ½	30. ½	29. 9	29. 9
Mean	29. 3	29. 2	29. 4	29. 6	29.4½	29. 4
Low	28. 8	28. 6	28. 8	29. 1½	29. 0	28. 9
Therm.	24.i	37.i	21.i	6½	13.s	45.s

July

	July	*Auguſt*	*Septem.*	*OEtober*	*Novem.*	*Decem.*
High	29. 7	29. 9	29. 9	30. ½	30. ½	30.1 ½
Mean	29.2 ½	29.5 ½	29. 3	29. 5	29. 5	29.2 ½
Low	28. 8	29.2 ½	28. 7	29. ½	28. 9	28. 3
Therm.	34.s	23.s	1 ½	15.i	30.i	43 i

The Barometrical Heights at *Peterſburgh*, A. D. 1724 and 1725.

	Dec.	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*
High	31.12	31.59	30.36	30.35	29.87	29.99	29.81
Mean	30.61	29.97	29.32	29 76	29.57	29 67	29 45
Low	30.11	28.36	28.28	29.18	29.28	29.35	29.10

The Heights of the Thermometer.

High	——	——	——	——	36.0	30 34	30 70
Mean	——	——	——	——	45 0	40.98	40.0
Low	——	——	——	——	54.7	52.8	40.63

By comparing theſe two Tables together, it is manifeſt that the *Mercurial Aſcents* are much greater at *Peterſburgh* than at *Lunden*, and that the *Deſcents* are nearly the ſame; ſo that the Range of the Barometer at *Peterſburgh* is 3 Inches, 31 hundredth parts; but at *Lunden* only 1 Inch, and about 8 Tenths. And the greateſt Height of the Thermometer at *Peterſburgh*, was on *May* 17, 30.34.

Of the Winds and Weather at Lunden, *in* 1724.

In *Jan.* the Winds were, for the moſt part, about the W. and S Points, and frequently very boiſterous. The Weather was ſome cloudy, ſome fair, frequent Rain, but no Cold taken notice of 'till *Jan.* 30.

In *Feb.* the Winds frequented the ſame Points as in *Jan.* but they lay more between the N. and E. than then; and they were very boiſterous oftentimes. In this Month Snow was frequent, and now and then Thunder, and but little fair Weather.

In *March* the Winds were very variable, and ſometimes ſtrong. The Weather more ſerene than before, with ſometimes Snow, and towards the latter End Rain, and now and then a Froſt.

In *April* the Winds were more Northerly and Eaſterly than in *March*, and not very ſtrong. The greateſt Part of the Month was freezing, and fair, with ſome Days of Rain with Thunder.

The Beginning of *May* to the 16th the Mornings were froſty, with ſome Rain, ſome Snow, and ſome fair the reſt of the Day; after the 16th ſome Rain and ſome Snow; and towards the End of the Month fairer. The Winds were variable, briſk, and about the 23d, 24th, and 25th, ſtormy.

In

In *June* the Winds variable, pretty briſk, and ſtormy on the 10th, 11th, and 12th; then the Weather for the moſt Part fair till the 15th; after that cloudy, and but little fair, with frequent and plentiful Rain.

July alſo was a cloudy, wet Month, with but little fair, and ſome Thunder, which was ſometimes violent. The Winds, for the moſt Part, were between the W. and S. and moderate.

In *Aug.* the Winds were more Northerly and Eaſterly than in *July*, and ſometimes between the W. and S, and moderate in all the Points. The firſt 9 or 10 Days were, for the moſt Part, fair; after that, 9 or 10 Days, more cloudy, Rain, Lightning in the Evening, loud Thunder and Rain in the Day, and ſome in the Night; and from the 20th to the Month's End fairer, with cloudy, Hail, and Rain.

In *Sept.* the Winds frequented the Northerly and Weſterly Points, were briſk, and ſometimes ſtormy; the Mornings, for the moſt Part, cloudy the 9 firſt Days, and fairer the reſt of the Day. The greateſt Part of the reſt of the Month was rainy, with Plenty of Snow on the 25th; then Rain, which continued in the Month of

Oct. during the 9 firſt Days; the reſt of the Month was cloudy, with now and then Hoar-Froſts, and ſome fair. The Winds varied often, but were the moſt frequent in ſome of the Southerly and Weſterly Points, and not very high.

In *Nov.* the Winds were ſometimes in the Weſterly and Southerly Points, but more frequent in the Northerly and Eaſterly, for the moſt Part of a moderate Strength. The 9 firſt Days the Weather was cloudy, then Snow and Froſt to the 17th; then to the End cloudy, Snow, Hoar-Froſt, Rain, and but little fair, and that in the Morning.

In *Dec.* the Winds were moderate, and often in the Southerly and S W Points, ſeldom Northerly. The 5 firſt Days were cloudy and wet; then Snow and Froſt the 6th, 7th, and 8th; then cloudy to the 13th; then Hoar-Froſt, and fair on the 14th, 15th, and 16th; then cloudy, with Thunder, Rain, Snow, and Froſt, at diverſe Times, in the reſt of the Month.

2. PART III. *Containing Meteorological Obſervations made at*

Berlin
Sweden { Lunden, Bettna, Upſale, Bygdea, Pithea } 1726.

Continued by the ſame, No. 433. p. 334. July, &c. 1734.

An Abſtract of *Meteorological Obſervations* made in the Year 1726, at *Berlin*, by the Society there, and communicated by *Joh. Theod. Jablonſki*; and in *Sweden*, at *Lunden*, by *Conrad Quenſel*, Math. Prof.

in

in the *Caroline* Academy; and at *Bettna* in *Sudermanland*, by *Andr. Geringius*, Paſtor and Provoſt of the Place; and at *Upſale*, by *Eric Burman*, Aſtron. Prof. in the *Guſtavian* Academy; and at *Bygdea*, in *Weſtro-Bothnia*, by the late *Jacobus Burman*, Paſtor of the Place; and laſtly, at *Pithea*, in the ſame Province, by *Olave Burman*, and *Iſrael Steckſenius*, Students.

Theſe Obſervations have, with ſo great Judgment, Diligence, and Care, been made, ſome twice, and ſome thrice every Day, that I wiſh they could be publiſhed as they are; but by reaſon they are too numerous and bulky to be capable of that, therefore I have contracted them as well as I could, to make them uſeful to the Society; and that not without a great deal of Trouble, by Reaſon of the Difficulty to give a tolerable brief Account of ſo great a Variety and Number of Obſervations, as are thoſe of the Winds, and their Strength, the Weather, the Barometer, Thermometer, *&c.* of ſo many Places, and ſo many Times every Day in the Year.

The moſt uſeful of the *Barometrical* Obſervations I have repreſented in the following Table; which ſhews, at an eaſy View, the higheſt, loweſt, and mean Heights of the Quickſilver in every Month, at the ſeveral Places.

	January.				February.			
	Berlin	Lun.	Bett.	Upſa.	Berlin	Lun.	Bett.	Upſa.
High	29.3	30.0 1/2	30.51	30.18	29.6	29.8 3/4	30.40	30. 2
Mean	28.7 1/2	29.3 5/8	29.92	29.58	28.6 1/4	29.1 1/2	29 74	29.53
Low	28.0 1/4	28.5 3/4	29 26	28.98	27.6 3/4	28.4 1/4	29. 8	28.86

	March.					April.				
	Berlin	Lun.	Bettna	Upſa.	Pithea	Berlin	Lun.	Bettna	Upſale	Pithea
High	29. 0 3/4	30.0 1/2	30 50	30.24	30.11	28.10	29.9 1/2	30 48	30.17	29.98
Mean	28. 5	29.4 1/2	29.79	29 28	29.35	28. 5	29.5 7/8	29.86 1/2	29.66	29.27 1/2
Low	27.10 1/2	28.8 1/2	29. 8	28.32	28.50	28. 0 1/3	29.2 1/3	29.25	29.15	28.57

	May.					June.				
	Berlin	Lun.	Bettna	Upſa.	Pithea	Berlin	Lun.	Bettna	Upſale	Pithea
High	28.9 1/4	30.0 1/2	30.40	30.16	30.11	28 7 1/2	29.9 1/2	30.20	30 00	29.98
Mean	28.4 1/3	29.7 3/8	30.77 1/2	29.84	29.74 1/2	27.9 1/4	29.4 1/3	29 67 1/2	29.62 1/2	29.56 1/2
Low	28.0 1/0	29.4 1/4	29.35	29.52	29 48	27.0 1/2	28.9 1/2	29.15	29.25	29.15

	July.					August.				
	Berlin	Lun.	Bettna	Upſa.	Pithea	Berlin	Lun.	Bettna	Upſale	Pithea
High	28.5 1/3	29.6	30. 5	29.88	29.56	28. 8	29.8 3/4	30.30	29 98	29.86
Mean	28.2 1/4	29.2 3/4	29.70	29.54	29.37 1/2	28. 3 1/4	29.3 5/8	29.65 1/2	29.48	29.28 1/2
Low	28.0 1/4	28.9 1/2	29.35	29.20	29.19	27.11 1/3	28.8 1/2	29. 1	28.98	28.71

	September.					October.				
	Berlin	Lun.	Bettna	Upſa.	Pithea	Berlin	Lun.	Bettna	Upſale	Pithea
High	28.6	29.7 $\frac{1}{4}$	30.28	30.00	29.80	28.10	30.1 $\frac{1}{2}$	30.55	30.25	29.90
Mean	28.1	29.1 $\frac{3}{4}$	29.57	29.29	29.20	28. 3 $\frac{1}{2}$	29.1 $\frac{7}{8}$	29.57 $\frac{1}{2}$	29.28 $\frac{1}{2}$	29.05
Low	27.8	28.5 $\frac{3}{5}$	28 87	28.58	28.60	27. 9	28.2 $\frac{1}{4}$	28.60	28.32	28.10

	November.					December.				
	Berlin	Lun.	Bettna	Upſa.	Pithea	Berlin	Lun.	Bettna	Upſale	Pithea
High	29 1	30.1 $\frac{1}{2}$	30.80	30 51	30.19	29.1 $\frac{2}{3}$	30.0 $\frac{1}{2}$	30 50	30. 7	29.80
Mean	28 7	29 5	30.00	29.73	29 24	28.4 $\frac{3}{4}$	29 5 $\frac{1}{2}$	29 65	28.83 $\frac{1}{2}$	29. 0 $\frac{1}{2}$
Low	28.1 $\frac{1}{4}$	28.9 $\frac{1}{2}$	29 20	28.90	28.29	27.8 $\frac{1}{4}$	28 4 $\frac{1}{4}$	28.80	28.60	28.21

Although this Table may give a good View of the *Barometrical Ranges* at the ſeveral Places in every Month of the Year 1726, yet I think it neceſſary to acquaint the Society with the great Agreement between the Aſcents and Deſcents of the ☿, ſometimes at the very ſame Time, and generally near it. If the ☿ was remarkably high or low, it was ſo in all, or moſt of the Places: If ſtationary for 3 or 4 or more Days, it was the ſame in all. Only the Alteration would begin, or end, ſomewhat ſooner, or later, perhaps, in one Place than another; and when any Deviation was from this Rule, it was commonly moſt remarkable in the *Pithea* Obſervations.

The *Thermometrical* Obſervations I can give no Account of, by reaſon I underſtand not the Thermometers there made uſe of, not the freezing, temperate, or other Points. Only the *Upſale* Thermometer (which was made by Mr *Haukſbee*) muſt ſerve for all: In which the Point of extream Heat is marked 5 Degrees above o; and ſo is graduated downwards to 45°, which is the Point of *temperate*; and 65°, which is the Point of *freezing*. The *Mean* of all the Degrees of every Month, at *Upſale*, the illuſtrious *Burman* hath noted according to Dr *Jurin*'s Directions; which is, by adding the whole Month's Degrees, and dividing by the Number of Days. Which *Means* I have inſerted, as well as my own; mine being the *Means* between the higheſt and loweſt Degrees, as well of the *Thermometer* as *Barometer*. And becauſe I forgot to inſert the *Barometrical Means* of the illuſtrious *Lunden* and *Pithea* Obſervers (which are according to Dr *Jurin*'s Way) but took only thoſe between the higheſt and loweſt Stations, therefore I have given this little Table of them.

A Table of the Mean Barometrical Stations, by Dr Jurin's *Way.*

January.		February.		March.	
Upſale	Pithea	Upſale	Pithea	Upſale	Pithea
29.76 $\frac{10}{31}$		29.47 $\frac{1}{14}$		29.51 $\frac{1}{31}$	29.28 $\frac{1}{18}$

April.		May.		June.	
Upſale	Pithea	Upſale	Pithea	Upſale	Pithea
29.76 $\frac{2}{5}$	29.49 $\frac{7}{15}$	29.91 $\frac{15}{31}$	29.82 $\frac{22}{31}$	29.59 $\frac{11}{15}$	29.49 $\frac{3}{5}$
July.		**August.**		**September.**	
29.53 $\frac{11}{31}$	29.38 $\frac{3}{19}$	29.54 $\frac{17}{31}$	29.27 $\frac{10}{31}$	29.34 $\frac{9}{10}$	29.14 $\frac{1}{6}$
October.		**November.**		**December.**	
29.43 $\frac{13}{31}$	29.11 $\frac{17}{30}$	29.81 $\frac{1}{10}$	29.49 $\frac{23}{30}$	29.66 $\frac{23}{31}$	29.19 $\frac{9}{31}$

A Thermometrical Table of the higheſt, loweſt, and mean Stations at Lunden *and* Upſale, *with the* Upſale *Means, according to Dr* Jurin's *Method.*

January.				February.			March.		
	Lun.	Upſa.	Upſa.	Lun.	Upſale		Lun.	Upſale	
High	79	96.		85	83.7		111	82.0	
Mean	58 $\frac{1}{8}$	74 8	81.2 $\frac{14}{31}$	65 $\frac{1}{2}$	74 3 $\frac{1}{2}$	74.1 $\frac{21}{28}$	84 $\frac{1}{2}$	67.5	69.1 $\frac{13}{31}$
Low	38	67.7		56	65		58	52 4	
April.				**May.**			**June.**		
High	149	60. 9		187	47. 8		188	46. 7	
Mean	116	56.56	53.7 $\frac{17}{31}$	156	32.54	33.0 $\frac{2}{31}$	158 $\frac{1}{2}$	30.55	34 0 $\frac{7}{10}$
Low	83	43. 3		125	18. 1		129	15. 4	
July.				**August.**			**September.**		
High	173	42. 4		156	52. 2		168	62.7	
Mean	146	32.54	33.7 $\frac{15}{30}$	134 $\frac{1}{2}$	41.60	43.5 $\frac{13}{31}$	133	50.4	43 5 $\frac{13}{31}$
Low	119	23. 4		113	32. 8		98	38.1	
October.				**November.**			**December.**		
High	122	70.7		90	84.3		83	94. 8	
Mean	102 $\frac{1}{2}$	61.7	61.8 $\frac{27}{34}$	71	73.0	72.1 $\frac{1}{28}$	61	80.57	79.8 $\frac{5}{31}$
Low	83	52.7		52	62.3		40	67. 7	

By this Table, eſpecially by the *Upſale* Obſervations, it appears, that the colder Months in this Year 1726, were not ſo exceſſive cold, as their Northerly Situation would incline one to imagine, *Upſale* itſelf being 60° N. But by the Table, ſome of the Days in *Jan. Feb.* and *March*, &c. at the Beginning of the Year; and of *Sept. Oct. Nov.* and *Dec.* at the latter End of it, may be obſerved to have had the Thermometer ſometimes not ſo low, or very little below the *freezing Point*. In *Jan.* and *Dec.* for Inſtance, when it was at 67.7, which was lower than in the other Months, it was not 3 Degrees lower than the *freezing Point*, at 65°.

But by the beſt Judgment I could make of the *Berlin* Thermometrical Obſervations, they ſeem to have had no leſs, if not more ſevere Weather, than in the Northern Parts, particularly than at *Lunden*, *Upſale*, and

and *Pithea*, where the Weather ſeems to have been milder than at *Bettna* and *Bygdea*; at which two Places I find they had frequently Showers and Storms of Snow, and more hard Weather than at the other *Swediſh* Places, or *Berlin*.

What the Cauſe of this different Warmth ſhould be, I leave others to judge, whether the Proximity of the Sea, or the Warmth of mineral Vapours, and the Guard of their Woods ſkreening off the cold Winds (which two latter I remember *Ol. Magnus* aſcribes much unto).

But for the better judging of the State of every Month, be pleaſed to take this View, which the curious Author of the *Bettna* Obſervations hath given, together with ſome Remarks of my own, from the other Places.

In *Jan.* he ſays, the Winter cold (which was very intenſe from the 23d of *Dec.* to the 15th of *Jan.*) began to abate, to the Diſadvantage of the Ways and Travelling.

In *Feb.* he ſays the Winter Weather continued all the Month, to the middle of *March*, with ſome Snow, and Froſt enough to benefit the Ways and Travelling.

March he ſays began with Snow, and ſtormy and grievous Cold; but towards the latter End, the Weather was milder, and more ſeaſonable to the Agriculture newly begun. On the 14th and 17th was an *Aurora Borealis*.

In this Month, on the 17th and 22d, at *Berlin* alſo there were Signs of *Auroræ Boreales*, as alſo on *Feb.* 23.

Alſo at *Upſale*, a *Lumen Boreale* was on *Feb.* 27, *March* 3, 15, and 16.

In *April*, *Bettna* is ſaid to have had a ſeaſonable Seed-time; and that the autumnal Corn, which had eſcaped the *Worm* (a Calamity I find common in thoſe Parts as well as *England*) began now to flouriſh.

At *Lunden* they had *Parhelii* on the 28th and 29th. At *Upminſter* we had the *Aurora Borealis*, or *Streaming*, in the Evening, *April* 12th.

In *May* the reverend and learned Obſerver at *Bettna* takes Notice, that by the continual and pernicious Heat of the Sun in this Month, the Corn was ſo burnt up, as to be a ſad Preſage of an enſuing Scarcity, and Dearth of Proviſions.

And at *Upſale* alſo, and *Berlin*, they mention great Drought, and exceſſive Heat of the Sun. But in ſome Parts of the Month, the Air at *Berlin* is ſaid to have been coldiſh.

In *June* the violent Heats were abated, and the Seaſon more moiſt and rainy. The Corn being too ſoon ripe, cauſed their Harveſt to fall out at a very unuſual Seaſon.

At *Lunden* and *Berlin* it was cold ſeveral Days and irkſome.

July I find was a rainy Month at *Berlin*, and moſt of the *Swediſh* Places (*Pithea* the leaſt). At *Bettna* it was very unwelcome to the Harveſt-men. Much Thunder alſo and Lightning was in moſt of the Places, chiefly at *Upſale*.

In *Aug.* I find a greater Agreement between the Winds than in the other Months, they, in moſt of the Places, blowing from ſome of the Points between the Weſt and South. At *Berlin* and *Upſale* was much Rain, at *Pithea* Thunder; and at *Bettna* the Beginning of the Month, being mild and fair, is ſaid to be a good Seed-time; but it is remarked, that for want of Rain the Seed came not up well.

Sept. was a very rainy Month in all the *Swediſh* Places, very cloudy, and ſome miſty, and ſnowy at *Pithea*; but at *Berlin* better Weather. At *Lunden*, a *Parhelius* on *September* 11th.

In *Octobe*r the *Swediſh* Places had many *Auroræ Boreales*. At *Lunden*, on *Oct.* 8, 12, and 24. At *Bettna* on the 8th, 10th, 12th, 13th, 15th, 22d, 26th. At *Upſale*, on the 3d, 6th, and eſpecially the 8th. And the ſame Evening of *Oct.* 8, at *Upminſter*, we had a very remarkable whitiſh Liſt, or Girdle went croſs the Heavens, from W. by S, to E. by N, about half a Degree broad; which continued but a little while, and then the whole Hemiſphere was covered with ſtreaming Vapours, in all Parts emitting Lances that pointed towards the Zenith, where they formed a Canopy; ſometimes reddiſh, ſometimes darker, and ſometimes blazing, as if ſet on Fire, and emitting Lances every Way, ſo as to make an Appearance of the Star which the Knights of the Garter wear. This Canopy moved ſometimes ſome Degrees Eaſtward, and then would return back again near the Zenith. When the Vapours and Lances ſhone out moſt, I obſerved a ſtrange Commotion and Working in them, as if ſome large Body was behind them, and diſturbed them. This *Aurora Borealis* being different from thoſe that uſually appear, I was minded to take this Occaſion of mentioning it with others that were ſeen at the ſame Time in *Sweden*.

The Weather in this Month was Rain, and hoar Froſts in the *Swediſh* Places, with much Snow at *Bygdea* and *Pithea*; a *Parhelius* at *Lunden*, *Oct.* 14: And the illuſtrious *Bettna* Obſerver ſaith, the Plenty of Rain this Month cauſed the Corn to thrive much; and he reckons the 31ſt Day of this Month to be then the firſt Winter Day with them, it being froſty, and Abundance of Snow that Day. At *Berlin* it ſeems to have been a dark and cloudy Month, with irkſome Cold towards the latter End.

In *Nov. Auroræ Boreales* were at *Lunden* on the 2d, 7th, and 8th; at *Bettna* the 2d. At *Lunden* and *Upſale* it was cloudy, foggy, Froſt, and Snow: At *Bygdea*, *Pithea*, and *Berlin*, fairer, with Froſt and ſevere Cold. At *Bettna* the Cold was very intenſe; the Heavens very cloudy and miſty.

In *December*, at *Lunden Auroræ Boreales* were on the 5th, 6th, 7th, 8th, 9th, 10th, 14th, 15th, 16th, and 22d Days; and at *Upſale* on the 5th and 6th; and at *Berlin* on the 7th and 12th there were Signals of the *Auroræ Boreales*. Froſt and Snow, cloudy and Fogs were at *Lunden*; at *Upſale* ſome cloudy and foggy, and a pretty deal of fair ſometimes: At *Berlin* much Froſt, Cold, and a great Storm of Wind on

the

the 23d: At *Pithea* frequent Snow, and ſome fair, ſome cloudy. *Bettna* is noted to have moderately Snow, but twice more intenſe Cold, to the great Benefit of the Ways and Travelling.

For the better underſtanding the foregoing Obſervations, and for a Concluſion of them, it is to be obſerved, that the *Lunden Barometrical* Obſervations were made with a *Barometer* graduated according to our *Engliſh* Meaſure, into Inches, and I ſuppoſe Decimals of Inches. But the Thermometer (as I ſaid) I underſtand not.

The *Bettna* Barometer alſo is graduated, according to *Engliſh* Meaſure, into Inches and Centeſms.

The *Upſale* Barometer and Thermometer were both made by Mr *Haukſbee*, and conſequently are according to *Engliſh* Meaſure; the Barometer having Inches and centeſimal Parts; the Thermometer as I have before deſcribed.

The *Bygdea* Obſervations the reverend Author did not live all the Year to finiſh, and there being none Barometrical, or Thermometrical, only a verbal Account of the Weather, and now and then of the Winds; therefore I have only, as Occaſion ſerved, taken Notice of thoſe Remarks.

The *Pithea* Obſervations had none Thermometrical; and thoſe of the Barometer ſeem to be in Inches and centeſimal Parts.

3. PART IV. *Containing Meteorological Obſervations made at* Naples, Bengal, Chriſtiana } 1727. *Continued by the ſame.*

An Abridgment of the *Meteorological Obſervations* made in the Year 1727, at *Naples*, by Dr *Nic. Cyrillus*, *Prim. Med. Prof.* and at *Bengal*, by the Rev. Mr *Bellamy*, Chaplain to the *Engliſh* Factory; and at *Chriſtiana* in *Norway*, by ——— communicated by Mr *Pr. Kink*. Extracted, for the Uſe of the *Royal Society*, by *W. Derham*, *F. R. S.*

I ſhall begin (as in my former Abſtracts) with a ſhort and eaſy View of the *Barometrical* and *Thermometrical Obſervations*, in theſe little Tables of them, which will be the more valuable, on account of the Obſervations being made (as I ſuppoſe) with ſome of the *Societies* Glaſſes, of Mr *Haukſbee*'s Preparation.

The *Barometrical Means* of *Naples* are, both as they are ſet down by the illuſtrious Obſerver himſelf, according to Dr *Jurin*'s Directions; and alſo as they are between the higheſt and loweſt Stations of every Month. Thoſe of *Norway* are in the latter Way.

JANUARY.

A Table of the Barometrical Ranges at Naples, *and in* Chriſtiana *at* Norway, *in the Year* 1727.

	JANUARY.		FEB.		MARCH.		APRIL.		MAY.	
	Naples		Naples		Naples		Naples		Naples	
High	29.80		29.88		30. 6		29 88		29.88	
Mean	29 55	29.65	29.63	29.72	29.59	29.73	29.71	29 72	29.71	29 73
Low	29.30		29.38		29.12		29 54		29.54	

	JUNE.			JULY.			AUGUST.		
	Naples		Norw.	Naples		Norw.	Naples		Norw.
High	29 72		29.3	29.80		29. 7	29.80		29. 7
Mean	29.60	29.64	29.1 ½	29 67	29.70	29. 3½	29 55	29.63	29. 5
Low	29.46		29.0	29 54		29. 0	29.30		29. 3

	SEPTEMB.		OCTOB.		NOVEMB.		DECEMB.	
	Naples		Naples		Naples		Naples	
High	29.88		29.88		30.06		29 88	
Mean	29.59	29.72	29.50	29.66	29.59	29.75	29 59	29.65
Low	29.30		29.12		29.12		29.30	

A Table of the Thermometrical Ranges at Naples, Bengal, *and* Chriſtiana, *in the Year* 1727.

	JAN.	FEB.	MARCH.		APRIL.		MAY.		JUNE.		
	Nap.	Nap.	Nap.	Beng.	Nap.	Beng.	Nap	Beng	Nap.	Beng.	Chriſt.
High	51.3	44.5	48.3	15.2	41.0	15.3	30.0	20.4	20.0	10.8	46
Mean	47.1	40 0	41.0	7.6	31 0	7.9	24.0	10 6	14.7	5.8	37
Low	43.0	35.0	34.5	0.1	21.0	0.6	18.0	0.7	9 5	0.8	29

	JULY.			AUGUST.			SEPT.		OCT.	NOV.	DEC.
	Nap	Beng.	Chriſt.	Nap.	Beng	Chriſt.	Nap.	Beng.	Nap.	Nap	Nap
High	17.0	15.4	40	21.0	15.4	45	25.0	10 4	43.5	47.0	50.5
Mean	10.0	7.7	35	11.1	7.8	35	19.7	7 7	32.2	43.7	43.2
Low	3.0	0 1	30	7.3	0.2	25	14.5	5 0	21.0	40 5	36.0

Theſe Tables give an eaſy View of the *Barometer* and *Thermometer* in the ſeveral diſtant Parts of the World ſpecified: Which would have been very inſtructive, had they been obſerved throughout the Year, as they were at *Naples*.

By the *Barometrical* Obſervations it appears, that the Aſcent and Deſcent of the Quickſilver is not ſo great at *Naples* as in the more Northerly Climes: For it was but twice in the whole Year above 30 Inches; and but thrice as low as 29.12 Inches. And ſo I obſerved, that at *Zurich* the Range is but about an Inch; but at *Upminſter* I find the higheſt Aſcent to have been 30.44 Inches; and the loweſt Deſcent 27.44 Inches, which is a Range of 2½ Inches: And by my Account of the *Peterſburgh* Obſervations in 1724, it appears that the Mercurial Range there is 3.31 Inches. And as for *Norway*, the Obſervations are too few,

ſew, and all made only in the Summer Months, whereby no good Judgment could be made: And *Bengal* had no *Barometer*.

By the *Thermometrical Table* we may judge of the Heat and Cold of the ſeveral Places. For the right underſtanding of which, I muſt repeat what I ſaid in a former Abridgment, *viz.* that in Mr *Haukſbee*'s Thermometers, the Point of *Extream Heat* is 5° above 0; that 45° below 0, is the Point of *Temperate*; and 65°, the Point of *Freezing*. But Dr *Cyril* ſaith it freezes with them at *Naples* when the Spirits are only got to 55°.

And as at *Naples* it *freezes* at a warmer Degree of the Thermometer, ſo I obſerve that at *Chriſtiana* the illuſtrious Obſerver complains of the *vehement Heat of the Sun* in *July*, when the Spirits were but at 36 and 34°; in *Aug.* at 25, 27, and 28 Degrees, he ſays, the *Weather was exceeding hot*. I thus diſtinctly mention (as the Author doth) the *Heat of the Sun*, and the *Heat of the Weather*, becauſe they may not mean the ſame Thing, I having been informed by the Whale-Fiſhers, that in *Greenland* the Heat of the Sun is ſcarce tolerable on one Side of the Ship, when on the other Side it freezes hard.

At *Bengal* the Heat at ſome Times ſeems to be very intenſe, by the Thermometer being, in ſome Months, more Degrees about the 0, than the Point of *extream Heat* is. As particularly in *April*, *May*, and *June*, it was 6, 7, and 8° above 0. But thoſe exceſſive Heats are generally in the Afternoons, the Forenoons being more temperate, and the Temperature, or what they call Cold there, is at the ſame Time of the Day. And the Degree of the Thermometer, at which they reckon it coldiſh, is about 15°. And on *May* 2d, at 8 in the Morning, Mr *Bellamy* ſaith (the Glaſs being then at 20.4 Degrees) *The Morning was like Winter Weather in Europe*.

Whether this ſo different Judgment of great Cold at *Bengal*, when the Thermometer was about 20°; and of exceſſive Heat at *Chriſtiana*, when it was but a little below that, *viz.* at 25°, *&c.* Whether, I ſay, this Difference of Judgment ariſes from ſome Prejudice of the Senſes, or from ſome extraordinary Quality in the Air, I leave (as Dr *Cyril* doth) to the Judgment of the learned Society.

As to the Weather, Winds, Rain, *&c.* of the ſeveral Places, it would be endleſs to meddle with Particulars, and therefore a tranſient View of every Month muſt ſuffice.

At *Naples*, *Jan.* was a cool Month, frequent Rain, with much Thunder and Storms of Wind. The Rain amounted to 111½ Meaſures (23 of which make an *Engliſh* Inch in Depth) which is 4 Inches 19½ Meaſures, or near 5 Inches Depth. *Veſuvius* was pretty quiet.

Feb. was a drier Month, the Rain amounting only to 14 Meaſures, which is but little above half an Inch deep. The Weather was for the moſt Part cloudy, with ſome Froſts. *Veſuvius* emitted a thick Smoak.

At

At *Naples*, in *March* it was cold, with Hail, and Snow on the Mountains, the Rain amounted to 101 Measures, which makes 4 Inches, 9 Measures Depth. The Winds were in all the Points. *Vesuvius* discharged Rivulets of Fire.

At *Bengal* the five last Days (which were all observed in this Month) were fair, the Wind S².

In *April* the Winds at *Naples* were much in the northerly Points, cold, frequent Thunder, the Rain only 38 Measures, which make 1 Inch, 15 Measures. No Fire in *Vesuvius* the Beginning of the Month, but towards the latter End, divers Rivers of Fire and Smoak.

At *Bengal* the Wind was much among the southerly Points, cloudy, some Rain and Thunder. The Weather for the most part temperate, but great Heats in the Afternoons.

In *May*, at *Naples*, the Wind lay much in the westerly and southerly Points. Rain 103 ½ Measures, which makes 4 Inches 11 ½ Measures Depth, with frequent Thunder. *Vesuvius* cast out Rivers of Fire, which reached almost to the Bottom of the Mountain.

At *Bengal* the Winds varying, but for the most part southerly, with much cloudy, Rain and Thunder. The beginning of the Month colder than ordinary; afterwards exceeding hot.

In *June* at *Naples*, the Wind was much in the westerly and north-westerly Points, but little Rain, only 6 ½ Measures, which is but about a quarter of an Inch depth.

At *Bengal*, much Rain with Thunder and Heat. On *June* 6th, it is noted, *we are now pretty certain the Rains are set in.*

At *Christiana*, the Observations begin on *June* 22d. The Weather temperate, and for the most part cloudy, with Thunder, Hail and Rain.

July, at *Naples*, was a very hot, dry Month, without any Rain, but frequent Mists. *Vesuvius* quiet.

At *Bengal* frequent and much Rain, with Thunder and Lightning; for the most part cloudy. Winds perpetually varying.

At *Christiana*, great Rains with Thunder, frequent Fogs, some fair, and Complaints of vehement Heat, although the Thermometer was but at 30 Degrees in that Month.

In *Aug.* at *Naples*, the Wind was in the westerly and north-westerly Points. Showers with Thunder were frequent, which amounted only to 49 ½ Measures, which is but a little above 2 Inches Depth. And although, by the Table, the Weather seems to have been warm, yet there are frequent Complaints of the Air being cold. *Vesuvius* cast forth a large River of Fire.

At *Bengal* much Rain, with Thunder and Cloudy. Winds varying, but pretty much Easterly. Weather sometimes very hot, but for the most part more temperate than in some of the other Months.

At

At *Chriſtiana* the Winds various; frequent Miſts, with cloudy, and ſometimes fair, and ſometimes Rain. Great Complaints of Heat, although by the Thermometer no great Signs of it.

In *Sept.* at *Naples*, the Winds various, and very ſtormy towards the latter End of the Month, with horrible Thunder, Lightning, and heavy Rain, which amounted to 220 ½ Meaſures, making 9 Inches 13 ½ Meaſures in Depth; which was more than fell in any Month of this Year, and drowned the Marſhes, and did a great deal of Damage to Houſes, Trees, *&c.* *Veſuvius* was quiet at the Beginning, but fiery at the End.

Bengal, hath only the 7 firſt Days Obſervations where the Wind was moſtly eaſterly, cloudy, and ſhowery, with Thunder and Lightning.

The Obſervations of the remaining Months are all of *Naples*; where, in

Oct. the Wind was various, and ſometimes ſtormy, with Thunder; frequent Miſts, and ſometimes heavy Rain, amounting to 107 Meaſures, which make 4 Inches 15 Meaſures, and in the Mountains Snow. *Veſuvius* turbulent in the beginning of the Month, and emitted a River of Fire.

Nov. was, for the moſt Part, a cloudy miſling Month, with Thunder and Rain; but of no greater Quantity than 73 Meaſures, which are equal to 3 Inches 4 Meaſures Depth *Engliſh*. The Wind was more northerly than in any other Quarter. The Fire of *Veſuvius* leſs.

Dec. was a wet, unſeaſonable Month, the Rain being 179 Meaſures, which is 7 Inches 18 Meaſures in Depth; which following the Rains and unſeaſonable Weather of the preceding Months, ſo damaged the Fruits of the Earth, that publick Prayers were ordered for fair Weather.

The Rain of the whole Year the illuſtrious Obſerver computes at 3 *Engliſh* Feet 7 Inches and 14 ½ Meaſures. And to ſhew how much wetter this Year was than the others, he gives theſe Quantities of the Year 1724, 2 *Engliſh* Feet 10 Inches, 14 Meaſures; of 1725, 2 Feet 10 Inches, 17 Meaſures; of 1726, 1 Foot, 11 Inches, 14 ½ Meaſures.

Continued by the same.

4. PART V. *Containing Meteorological Observations made at* Hall *in* Saxony, 1729.

Goslar
Wittemberg
Naples
Southwick
Sweden: Lunden, Swenæker, Risinge, Bettna, Upsale, Hudiskswald, Hernœsand, Bygdea
} 1728.

An Abstract of *Meteorological Observations* made at *Hall* in *Saxony* in 1729, by *Joh. Joach. Langen*, Math. P. P. O. and in the Year 1728, at *Goslar* in *Lower Saxony* in *Germany*, by *Joh. Conrad. Trumphius*, M. D. & Pract. *Goslar* at *Wittemberg* in *Saxony*, by *Joh. Fred. Weidler*, J. U. D. & Math. Super. Prof. in Acad. *Witteb.* at *Naples*, by *Nic. Cyrillus*, in Urbe *Neap.* Pr. Med. Prof. at *Southwick* in *Northamptonshire*, by *George Lynne*, Esq; and in *Sweden*, at *Lunden*, *Bettna*, *Upsale*, and *Bygdea* (mentioned in 1726,) to which the illustrious Observers have added Observations from *Swenæker*, in *Westro-Gothia*, Latitude 58° 10′, by *Torstanius Vassenius*, V. D. Minist. in *Wassenda*; at *Wisingsæ*, by *Magnus Oxelgren*, Lect. Gymnasii; at *Risinge* in *Ostro-Goth*, by *Sueno Laurelius*, Past. and Provost, at *Stockholm*, Lat. 59° 30′, by *Joh. Backman*, Citizen; at *Hudickswald Helsingorum*, by *Olave Broman*, Pastor there; at *Hernæsand* and *Angermann*, by *Jack. Renmarck*, Math. Lectore; at *Lœfanger* and *Umea*, Lat 63° 43′, by *Bern. Ask*, Theol. Stud. and at *Torneao*, in *Westro-Goth.* Lat. 65° 43′, by *Abr. Fought*, Pastor there. Extracted for the Use of the *Royal Society*, by *William Derham*, D. D. F. R. S.

A Table of the Highest, Mean, and Lowest Barometrical Stations, in the Year 1728.

	JANUARY.			FEBRUARY.			MARCH.		
	High	Mean	Low	High	Mean	Low	High	Mean	Low
Hall	29.4 1/2	28.7 1/2	28.1 1/3	29. 7	28.10	28. 2	29. 2	28.9 1/2	28. 5
Goslar							31. 3	30.10	30. 6
Wittemberg	30.2 1/2	29.5 3/4	28. 9	30.2 7/8	29. 9	29. 3	29.9 7/8	29. 5	29.1 1/3
Naples	29.88	29.50	29.12	29 88	29.71	29.54	29.88	29.63	29.38
Southwick	30.08	29.37	28.67	30.10	29.84	29.58	29.88	29.35	28.83
Lunden	30.20	29 46	28.72	30.22	29.52	28.82	29.81	29.16	28.51

JANUARY.

	January.			February.			March.		
	High	Mean	Low	High	Mean	Low	High	Mean	Low
Swenæker	30.36	29.68	29. 0	30.35	29.32	28.29	29.73	29 05	28.37
Risinge	30.20	29.55	28.90	30 20	29.52	28.85	29.67	29. 0	28.20
Bettna	30.80	30 10	29 40	30.80	30.1	29.45	30.21	29.55	28.90
Upsale	30.46	29.85	29.24	30.50	29.86	29.23	30 00	29 40	28.80
Hudickswald	30.50	29 75	29.01	30 56	29.89	29.22	30.24	29 52	28.80
Hernœsand	30.60	29.95	29.30	30.50	29.79	29. 8	30.25	29 47	28.70
Bygdea.	30.30	29.75	29 20	30 40	29 67	28.94	30.28	25 39	28.50
	April.			May.			June		
	High	Mean	Low	High	Mean	Low	High	Mean	Low
Hall	28.11	28. 8	28. 5	29.1 $\frac{1}{3}$	28. 8	28.3 $\frac{1}{2}$	29 0 $\frac{3}{4}$	28. 8	28. 3
Goslar.	31. 4	30.11	30. 6	31. 5	31.0 $\frac{1}{2}$	30. 8	31. 4	31.0 $\frac{1}{2}$	30. 9
Wittemberg	30. 0	29.4 $\frac{1}{2}$	28. 9	30. 1	29. 8	29.2 $\frac{1}{2}$	30. 0	29.8 $\frac{1}{2}$	29. 5
Naples	29 88	29.75	29.63	29.80	29.71	29.63	29.88	29.75	29.63
Southwick	29.94	29.48	29 03	29 96	29.51	29 07	29.93	29.70	29.27
Lunden	29.73	29.22	28.51	30.02	29 57	29.12	29.83	29 52	29.21
Swenæker	29.83	29 05	28.27	30.07	29.26	28.45	29.93	29.49	29.06
Risinge	29.70	29.06	28.43	29.95	29 35	28.75	29.70	29 35	29 00
Bettna	30.22	29.63	29 05	30.50	29.90	29 30	30.20	29.89	29.58
Upsale	30.00	29 49	28 98	30.29	29.73	29 17	30.09	29.73	29 38
Hudicksfwald	30.10	29.60	29.10	30.38	29.79	29.20	30.96	30.09	29 22
Hernœsand	30. 7	29 50	29.07	30.20	29.72	29.24	30.10	29.71	29.32
Bygdea	29.80	29.40	29.00	30.10	29 62	29.14	29.96	29.42	28.88
	July.			August.			September.		
	High	Mean	Low	High	Mean	Low	High	Mean	Low
Hall	28.11	28. 8	28. 5	29. 0	28.8 $\frac{1}{2}$	28. 5	29. 1	28.10	28. 8
Goslar	31. 3	30.11	30. 7	31. 5	31. 0	30 9 $\frac{1}{2}$	31. 5	31.0 $\frac{1}{2}$	30. 8
Wittemberg	30. $\frac{3}{4}$	29. 7	29.3 $\frac{1}{2}$	30. $\frac{1}{2}$	29. 8	29.4 $\frac{1}{2}$	30. 0	29.7 $\frac{1}{2}$	29. 3
Naples	29.80	29.71	29.63	29.88	29.80	29.72	29 88	29.54	29.21
Southwick	29.95	29.57	29.20	30 04	29.51	28.98	30.02	29.53	29 04
Lunden	29.73	29.38	29.02	29 92	29.37	28.82	29.91	29.45	29 00
Swenæker	30 10	29.19	28.28	29.74	29.19	28.64	29.93	29.39	28.86
Risinge	29.50	29.15	28.80	29.57	28.86	28.15	29.95	29.32	28.70
Bettna	30.12	29.66	29.20	30.10	29.56	29.02	30.38	20.83	29.28
Upsale	29.91	29.55	29.20	29 91	29.45	29.00	30.17	29.71	29.25

	July.			August.			September.		
	High	Mean	Low	High	Mean	Low	High	Mean	Low
Hudickſwald	30.05	29.61	29 18	29 90	29.48	29 07	30 21	29.74	29.27
Hernœſand	29.97	29.53	29.10						
Bygdea	29.85	29 42	29 00	29 96	29.58	29.20	30. 2	29.53	29.05
Torneao				29 85	29.56	29.27	29 92	29.56	29.20

	October.			November.			December.		
	High	Mean	Low	High	Mean	Low	High	Mear	Low
Goſlar	31. 5	31. 0	30. 6	31. 6	30. 5	30. 6	31. 8	31. 1	30. 4
Wittemberg	30. 2	29. 6	29. 2	30. 3	29. 0	28. 9	30. 2	29 6	29. 1
Naples	29 80	29.71	29 52	29.96	29 67	29.38	29.80	29.51	29 21
Southwick	29 98	29.31	28.64	29.95	29.45	28.91	30.04	29.42	28.80
Lunden	30.12	29.51	28.90	29 90	29 26	28 62	29.92	29 32	28.73
Swenæker	30.26	29.55	28.84	29.95	29.14	28.34	30.16	29.53	28.91
Riſinge	30.16	29 43	28.70	29.80	29.05	28.30	30 05	29.42	28.80
Bettna	30.80	30.02	29.25	30.40	29.70	29 01	30.70	30.11	29.52
Upſale	30 49	29 83	29.16	30 10	29 44	28.79	30.49	29 87	29.25
Hudickſwald	30.97	29.99	29.01	30.22	29 47	29.72	30 00	29 95	29.30
Bygdea	30.40	29.70	29. 0	30.24	29.42	28.60	30.50	29.80	29.10
Torneao	29.90	29.58	29.25						

A Thermometrical Table of the Higheſt, Loweſt, and Middle Stations at Naples, Southwick, Lunden, *and* Upſale, *in* 1728.

	January.			February.			March.		
	High	Mean	Low	High	Mean	Low	High	Mean	Low
Naples	49.05	43. 5	38. 5	48. 0	44. 5	35. 0	39. 5	35. 9	32. 3
Southwick	79	67	55	80	67	54	69	57	45
Lunden	83	68	54	91	73	56	123	98	74
Upſale	91. 5	80. 9	68. 3	89. 2	77. 9	66. 6	72. 1	63. 0	53. 9

	April.			May.			June.		
	High	Mean	Low	High	Mean	Low	High	Mean	Low
Naples	42. 5	33. 2	24. 0	26. 0	18. 5	11. 0	16. 0	9. 7	4. 5
Southwick	71. 0	53	36	56	40	24	50	35	19
Lunden	148	118	85	172	145	118	176	153	130
Upſale	69. 5	52. 1	44. 7	54. 7	45. 0	35. 3	42. 0	33. 6	25. 2

	July.			August.			September.		
	High	Mean	Low	High	Mean	Low	High	Mean	Low
Naples	13. 5	8. 2	3. 0	16. 0	10. 0	4. 0	26. 5	17. 1	7. 7
Southwick	50	34	17	56	39	23	65	48	32
Lunden	172	152	132	153	133	113	150	122	94
Upsale	37. 2	31. 0	25. 5	40. 2	32. 8	25. 5	58. 4	46. 2	34. 6
	October.			November.			cember.		
	High	Mean	Low	High	Mean	Low	High	Mean	Low
Naples	40. 0	31. 3	22. 5	48. 0	42. 0	34. 0	54. 5	54. 5	44. 7
Southwick	71	56	41	84	64	43	87	72	58
Lunden	119	98	78	109	87	64	83	71	59
Upsale	68. 2	58	47. 7	98. 0	57. 0	56. 1	89. 6	76. 8	64. 0

A Table of the Rain at Southwick *and* Naples *in the Year* 1728.

	Southwick	Naples		Southwick	Naples
	Inch. Cent.	Inch. Measures		Inch. Cent.	Inch. Measures
January	4. 00	4. 15½	July	3. 21	0. 00
February	0. 99	0. 00	Aug.	0. 96	0. 00
March	3. 27	0. 5	Sept.	0. 86	4. 4
April	1. 97	0. 14	Oct.	2. 79	6. 17½
May	1. 44	0. 00	Nov.	1. 52	2. 7
June	2. 82	1. 2½	Dec.	2. 43	6. 8½

Rain in the whole Year,

At Southwick, *is* 26 *Inches, and* 26 *Centesimals.*

At Naples, *is* 19 *Inches, and* 14 *Measures.*

Remarks on the Meteorological Observations of the Year 1728.

As the Observations of this Year, which the *Royal Society* hath received from many, and very distant Parts of the World, are too large and numerous to be printed in the *Philosophical Transactions*, or read at the Society's Meetings; so to make them as useful as possible, I have put as many of them as I could into Tables, to be seen and compared at an easy View, as I have done in former Years: But I am forced to omit such of them, where no Account is given of the Instruments they used, or where none were made use of at all, but only verbal Descriptions given, that Tables would not admit of. But the Places mentioned in the Tables, had the Society's Glasses of Mr *Hauksbee*'s making.

The *Barometrical* Observations I need not satiate the Society with Remarks upon, because I have made divers of that Kind, upon the preceding Years: only I shall repeat two Things that I formerly took notice of, and have had frequent Confirmations of this Year; *viz.*

1. The

1. The great Conformity of the Aſcents, Deſcents, and Stations of the Mercury in the Barometer. 2. That the Range of the Mercury is much greater in the Northerly than Southerly Climes.

As for the *Thermometrical* Obſervations, I have inſerted all that were made with the *Royal Society*'s Glaſſes: But ſuch as were made with other Thermometers, it would have been of little or no uſe to have taken Notice of them, unleſs I could have reduced them to ſome known Meaſure; which only two of the curious Obſervers enabled me to do; but I found that a Matter ſo perplext and difficult, as not to anſwer the great Trouble of it, eſpecially conſidering that theſe Tables exhibit Obſervations made in different and diſtant Parts, *viz. Italy*, *Germany*, *England*, and *Sweden*, by which an Eſtimate may be, in ſome meaſure, made of the Temperature of thoſe different Climates of the World. In order to which, I muſt repeat what I mentioned in ſome preceding Year; that in the *Royal Society*'s Glaſſes, the Point of *Extream Heat* is 5° above 0, that *Temperature* is 45° below 0, and *Freezing* at 65°. And if we caſt our Eye upon the ſeveral Months, particularly thoſe of Winter, eſpecially if we conſider that which I have remarked in 1727, from Dr *Cyril*, concerning the *Freezing-Point* at *Naples* to be at 55°, which is at *London* at 65°, and at *Chriſtiana* and *Bengal* probably as different alſo. I ſay, conſidering theſe Things, it is ſurprizing that the Heat and Cold of thoſe diſtant Places, is not as different as their Northerly and Southerly Situations. But at *Lunden*, I was ſurprized to find the Thermometer much lower in the warmer Months than at *Upſale*, or any other of the *Swediſh* Places, 'till I found that in all thoſe Months, they had continual Cold and Rain, when the other Places mention little but fair, or cloudy, and but little Rain or Cold. And this minds me of a former Obſervation, *That Cold is the Parent of Wet*, eſpecially in Summer.

As to the *Winds* and *Weather*, ſo many are the Places of Obſervation, and ſo many and ſo various the Obſervations, that it is next to impoſſible to give a tolerable Abridgment of them: and therefore my Remarks on the foregoing Years, eſpecially on the ſame Places and Parts of the World, muſt ſuffice here.

The Quantity of *Rain* and *Snow* were obſerved at *Naples*, *Riſinge*, *Bettna*, *Upſale*, *Hudickſwald*, and *Southwick*: But I find no Deſcription of the Inſtruments wherewith they obſerved, nor of their Meaſures, except at *Southwick* and *Naples*, and therefore am forced to omit all but the two latter, in which the Depth is meaſured by *Engliſh* Meaſure, the *Southwick*, by Inches, and hundredth Parts of an Inch; and the *Naples*, by *Engliſh* Inches, and the Obſerver's Meaſures, 23 of which make an *Engliſh* Inch.

Laſtly, That I may omit as little as may be of what the illuſtrious Obſervers take Notice of, I ſhall add the Meteors they mention, together with ſome of my own, that happened about the ſame Time.

The

The firſt was a *Lumen Boreale* at *Bettna*, in the Night after *March* 20; and at half an Hour after 8 on *March* 22, at *Windſor*, I ſaw an unuſual ſort of *Streaming*, in which the Columns were not (as uſually) conical, or pointed, not riſing towards the Zenith-Point; but were with parallel Sides, and roſe perpendicularly to the Horizon. They were very bright, emitting a Light equal to that of the Moon in her Quarters. Alſo they roſe from a Bank of Vapours, not curved at Top (as uſually) but lacinated, or broken.

Alſo on *March* 24, the curious *Bettna* Obſerver ſaith, there was, the Night before, *Lumen Efflammans Boreale*; which was alſo ſeen at *Læſanger*.

On *Aug.* 26, at Night was a remarkable *Lumen Boreale* at *Bettna*. And the Night before at $10^h\ 20'$ *p. m.* a Gentleman going from my Houſe, ſaw towards the E. about 30° high, a *Ball of Fire*, about 4 Inches Diameter, blazing, and ſtanding ſtill at firſt, and preſently after, it ran towards the N. and in about 5, or more Minutes, he heard an Exploſion like Thunder. It's Blaze emitted a Light equal to that of the Moon at Full.

At the ſame Time, the News-Papers ſay, a *Light* in the Sky, like a Comet, was ſeen at *Watford* in *Hertfordſhire*, with Sparks of Fire iſſuing from it's Tail; that then it brake out with a prodigious Luſtre, like the Sun, which laſted not long, and was followed with a terrible Clap of Thunder, the Stars twinkling all the while, and not a Cloud to be ſeen. Which Clap, I doubt not, was the ſame which my Friend heard, and which was 5 or more Minutes in it's Paſſage hither.

At *Bettna*, *Lumina Borealia* were ſeen on the Nights after *Sept.* 18, 19, and 24; the ſecond of which covered half the Heavens. And on *Sept.* 21, about 10 Hours *p. m.* I obſerved, at *Upminſter*, an unuſual ſort of Tan-coloured thick Vapours towards the N W *b* N but withal lightſome, and ſuch as the Stars might be ſeen through. And after ſome Time, they ſent forth, in divers Places, *Streaming Lances*, gently and gradually coming and going.

On *Oct.* 13, I ſaw that uncommon ſort of *Streaming* at *Redbridge*, near *Southampton*, and the ſame Night at *Bettna* was *Lumen Boreale eructans Flammam*, as the Obſerver expreſſes it. At *Læſanger* alſo thoſe Streamings were on the ſame Night, and on the 15th, 18th, 19th, and 23d.

On *Oct.* 19, a *Parhelius* was at *Lunden*, and on the 22d a *Lumen Boreale* at *Wittemberge*.

On *Nov.* 12, at *Windſor*, we had conſiderable *Streaming*; and the ſame was at *Bettna* and *Umea*; and on the 29th at *Læſanger*; and again at *Umea* on *Dec.* 24.

After I had finiſhed the foregoing Obſervations on the Year 1728, I received the curious Obſervations of the illuſtrious Marquis *Poleni*, made at *Padua*, for ſix Years; ſuch of which as are conformable to mine, I ſhall ſubjoin by way of Appendix.

An Appendix to the Remarks on 1728, *and ſome of the Years preceding it.*

The

The firſt thing he gives an Account of is, the *Quantity of Rain and Snow* (in *Engliſh* Meaſure. and according to the Old Stile) that fell before and after this Year 1728, in ſix Years Time, in the following Table.

A Table of the Rain at Padua, *in the Years* 1725, 1726, 1727, 1728, 1729, 1730.

	1725	1726	1727	1728	1729	1730
	Inch. Dec.	Inch. Dec.	Inch. Dec.	Inch. Dec.	Inch. Dec.	Inch. Dec.
January	0 .521	1 .355	5 .955	4 .278	1 .085	0 .112
February		1 .460	1 .073	1 .050	1 .245	2 .906
March	0 .889	3 .168	1 .878	4 .832	2. 902	4 .592
April	4 .019	3 .998	0 .498	1 .419	2 .768	1 .638
May	3 .625	1 .368	3 .530	3 .403	2 .634	4 .467
June	0 .036	2 .608	2 .476	2 .103	3 .134	6 .205
July	2 .297	2 .357	2 .930	4 .016	4 .526	2 .339
Auguſt	5 .185	1 .268	5 .067	5 .186	0 .578	4 .269
September	2 .647	2 .900	4 .164	6 .948	3 .267	1 .090
October	7 .104	0 .179	6 .576	5 .163	6 .294	5 .254
November	3 .636	2 .277	5 .091	6 .836	4 .186	0 .534
December	0 .030	2 ,390	7 .169	7 .599	2 .804	0 .894
Year	29.989	25.328	46.407	52.833	35.423	34 300

From this Table he obſerves, that the *Februaries* were the drieſt *Months*, and 1726, the drieſt *Year* in all the ſix, and that the *Octobers* were the wetteſt *Months*, and 1728 the *wetteſt* of all the ſix Years.

Further alſo he ſaith, that in the four *Seaſons* of the Years (reckoning their beginning from the 10th Day of their reſpective Months, *viz.* of *Dec. March*, *June* and *Sept.* that I ſay) leſs wet falls in Winter and Spring, than in Summer and Autumn, and that the wet Weather increaſes, as the Seaſons advance; that in Winter is the leaſt wet; that it increaſeth in Spring; is more in Summer; and moſt of all in Autumn.

For the Proof of this, he hath made a Table of the mean Quantities of the Rain in the four Seaſons of each of the ſix Years; the Sums of which ſix Years Rain, are in Winter, 39,490 Inches; in Spring, 52,188 Inches; in Summer, 58,25 Inches; and in the Autumn, 74,558 Inches. But in the many Years that I obſerved the Weather at *Upminſter*, I find it not ſo.

After theſe Obſervations of the Weather, the illuſtrious *Marquis* proceeds to the *Barometrical Indications* of it; and hath made Tables of the riſing and falling of the Quickſilver, together with the Courſe of the Winds, both againſt Rain, and alſo againſt Snow, hoping to predict from thence the ſeveral ſorts of Weather. But I omit the Tables, becauſe I think little of general Uſe can be concluded from them but what is commonly known.

I omit

I omit alſo his Table of the Sum and Mean Altitudes of the Barometer, and Thermometer; but his following Table may be of Uſe.

A Table of the higheſt and loweſt Stations of the Barometer, with the Winds and Weather.

Year	Month	Day O. S.	Barometer higheſt	Barometer loweſt	Winds	Weather at the ſame Time
	Janu.	19	30.28		W	Fair
1725	Dec.	8		28.56	S W 4	Cloudy
	Nov.	28	30.18		N	Fair
1726	Feb.	13		28 92	S W	Cloudy
	Nov.	20	30.24		N W	Fair
1727	Octob.	29		28.80	S 2	Cloudy
	Dec.	2	30.20		N	Thin Clouds
1728	Dec.	12		29.00	N W	Small Rain
	Dec.	20	30.30		W	Somewhat cloudy
1729	Nov.	10		28.90	N	Rain
	Dec.	20	30.40		N	Fair
1730	Feb.	27		28.98	S E	Sunſhine with cloudy

From this Table it appears, from the higheſt and loweſt Stations in the ſix Years, that the greateſt Range of the Barometer is 1.84 Inches; but at *Naples* it is only 94 Centeſimals of an Inch; and what it was at other Places, I have given ſome Account of in my Remarks on 1727.

The illuſtrious Obſerver hath alſo been very curious and ſedulous in his Obſervations of the *Thermometer*; which I am ſorry I can give no acceptable Account of, for want of ſo much Knowledge of his Thermometer, as may enable me to compare his Obſervations with mine.

He hath alſo compared with his own, the Quantities of *Rain*, and the *Barometrical Range* obſerved at *Paris*, by M. *de la Hire*; and finds that the *Paris Rain* is $16.4\frac{7}{12}$ Lines, and the *Barometrical Range* $2\frac{5}{12}$ Lines more than the *Padua*.

The laſt Thing which the illuſtrious *Marquis* takes Notice of, is the *Magnetical Declination*, which he ſaith is 13 Degrees *Weſt*, and hath decreaſed in the ſix Years $\frac{10}{60}$ths; that every Day there is a ſmall Alteration in the Declination, ſo that it doth not continue the ſame a whole Day together; that the Declination of all Needles (eſpecially if touched by different Magnets) is different a few Sexageſims. But theſe Niceties I recommend to the Enquiry of the Curious, becauſe they diſagree with the Obſervations of *Gilbert*, and moſt of the Magnetical Writers.

An Account and Abſtract of the Meteorological Diaries communicated to the Royal Society, *for the Years* 1729 *and* 1730. *By* Geo. Hadley, *Eſq; F R. S.* No. 447. p. 154. Jan. &c. 1738.

LVII. 1. The Society having been pleaſed to refer to me, on the Death of Dr *Derham*, the Meteorological Diaries tranſmitted to them from the curious Obſervers both at Home and in foreign Parts; as ſoon as they were put into my Hands, I applied myſelf to make an Abſtract of them in ſuch Manner as I judged may be moſt uſeful, and have nearly purſued the Method of Dr *Derham*, beginning at the Year 1729, where he left off.

Before I proceed to the Tables, I think it proper to give ſome Account of each of the Diaries of theſe two Years, and their Contents, that any Member of the Society, that may have Occaſion to make farther Inquiries into theſe Matters, may be acquainted with what is to be found therein, and what Pains have been beſtowed by the curious Obſervers.

The Diary kept by Mr *Haukſbee*, by Order of the Society, at their Houſe in *Crane-Court*, conſiſts of Obſervations of the Barometrical Heights twice a Day, *i. e.* Morning and Evening, in Inches, Decimals, and Centeſimals; the Thermometer likewiſe, in it's proper Graduations, which, I ſuppoſe, are already well known to the Curious, and the Weather, with the Hour of each Obſervation. The Winds are omitted. The Depth of Rain is ſet down ſeveral Times for the moſt Part in each Month, the Sum of which is to be divided by 10, the Funnel which catches the Rain being ſo much bigger in Surface, than that of the Veſſel which receives the Rain from it.

That from *Southwick*, near *Oundle* in *Northamptonſhire*, by *George Lynne*, Eſq; contains the Height of the Barometer once a Day, and the Winds, the Steadineſs and Strength of which is likewiſe marked with proper Marks and Figures. Obſervation is made of the upper and under Currents of the Air, when it ſo happened. The Thermometer is marked twice a Day; the Weather often, both by Day and Night; the Rain from Time to Time, and the Quantity of each particular Shower often ſet down by itſelf, with ſome other miſcellaneous Obſervations, as Haloes, Thunder-ſtorms, and ſudden Changes of Wind, *&c.* He takes Notice of his Thermometer being placed in an Outhouſe expoſed to the Air, but ſcreened from the Sun, which is a proper Precaution in uſing that Inſtrument. The remarkable Riſes and Falls of the *Mercury* are alſo marked with proper Marks; which Method would be uſeful in the other Columns alſo, for Compariſon of Diaries, if ſome certain Rule were agreed on.

That from *Kent*, 16 Miles S E from *London*, gives an Account of the Barometer once a Day, ſometimes twice or thrice, with the Hour of each Obſervation, and the Winds, Weather, and Rain, the Proportion of which for every Day is given at the End of each Month. There is alſo a ſeparate Column for the Height of the Clouds, which he divides into 3 Orders; and where there are 2 Orders at a Time, they are both noted; as alſo when any of them move with different Velocities or Directions, which he ſuppoſes to be commonly a Sign of

Change

Change of the Wind: But he does not inform us by what Method he determined their Heights or Velocities. The reigning Wind, and general Strength of it, is noted at the End of each Month; the Eclipſes alſo, and the Times of the New Moons; which he obſerves make it appear, that the Notion of the Change of Weather depending on the Age of the Moon, is without any Ground: With other Miſcellaneous Obſervations; as the *Aurora Borealis*, Fruitfulneſs or Sterility of the Seaſon. He had no Thermometer.

That from *Hudickſvall* in *Sweden*, by Mr *Olive Broman*, ſhews the Height of the Barometer ſometimes once, ſometimes twice or thrice a Day, *O. S.* in *Engliſh* Meaſure, with the Winds, and the Strength of them, and the Weather. There is alſo to the Diary 1729, annexed an Account of the Height of the Sea Water for every Day, which I obſerve varies in the whole about 2 Inches, and is ſometimes interrupted by Floods from Rain. This, I ſuppoſe, may relate to the Tides in the Gulph of *Bothnia*. I have not inſerted theſe in the Tables, not being of general Uſe. There is no Thermometer, nor the Quantity of Rain, ſet down.

That from *Riſinge* in *Oſtrogothia* in *Sweden*, by *Sueno Laurelius*, Paſtor and Provoſt, gives the Height of the Barometer, for the moſt Part, 3 Times, ſometimes 5 Times a Day, with the Hour of the Obſervations, *O. S.* in *Engliſh* Meaſure. He refers for the Deſcriptions of his Barometer and Thermometer to the Diary 1727. The Winds, with the Degree of their Strength, Weather, and Depth of Rain, are alſo ſet down.

In that from *Upſale* in *Sweden*, by Mr *Andrew Celſius*, *Aſtr. P. R.* and *F. R. S.* Obſervations are made 3 Times a Day of the Barometer and Thermometer, both which Inſtruments were made by Mr *Hauksbee*; the Winds, with their Strength, and the Weather, and Depth of Rain, from Time to Time.

That from *Svenaker* in *Sweden*, near *Trollhetta*, by *Torſtanus Waſſenius*, *V. D. M. &c.* contains the Height of the Barometer twice a Day, ſometimes 3 Times, *O. S.* in *Swediſh* Feet and Inches and Decimals, which being ſuppoſed to be in Proportion to *Engliſh*, as 974,375 to 1000, the mean Heights are reduced in the Tables following into that Meaſure. The Winds alſo, with their Strength, are noted, and the Weather. There is no Thermometer. Notice is taken of Thunder-Storms, and other Meteors *.

That from *Lunden* in *Sweden*, by Mr *Conrad Quenſel*, Math. Prof. in in Acad. *Carolina*, contains Obſervations of the Barometer twice a Day,

* *Note*, In the Account of the *Swediſh* Diaries 1728, *Svenaker* is ſaid to be 109 *London* Feet above the Surface of the Sea. The mean Height of the Barometer there in theſe two Years is but 29 Inches, 47, which would give the Height of the Place near 450 Feet, according to the Reckoning hereafter in this Paper; therefore I think there muſt be ſome Miſtake. Perhaps ſome Air might have got into the Top of the Tube, or the Scale placed too high.

O. S. in *Engliſh* Inches and Decimals, and 4ths of them; the Winds, with their Strength, and their Weather. The Thermometer is *Florentine*, and therefore the Obſervations not inſerted in the Table. The monthly Mean there given, is taken ſimply between the 2 Extreams: I have given it in the Tables taken the other Way, as all the reſt are.

That from *Bygdea* in *Sweden*, by Mr *John Telinus*, Paſtor there, has Obſervations of the Barometer twice a Day, Morning and Evening, *O. S.* in *Engliſh* Inches and Decimals; the Winds, with their Strength, and Weather. The 2 laſt Months are wanting. There is no Thermometer.

That from *Bettna* in *Sudermanland*, by Mr *And. Geringius*, Paſtor and Provoſt, has Obſervations of the Barometer thrice a Day, except in the firſt Part of *Jan. O. S.* in *Engliſh* Inches and Decimals; the Winds, with their Strength, and Weather, with other Meteorological Obſervations, and upon the Seaſons, as to Fruitfulneſs and Sterility, *&c.* The *Aurora Borealis* is frequently mentioned. The Thermometer is peculiarly graduated, and ſo could not be inſerted. There is a Column for Rain, with Marks, which I underſtand not.

From *Wittemberg* in *Saxony*, there are two Diaries communicated, one from Mr *Mat. Haſius*, Math. Prof. the other from Mr *J. Fred. Weidler*, LL. B. and *Math. Prof. Primar.* That by Mr *Haſius* has the Height of the Barometer ſeveral Times a Day, ſometimes four or five Times, *O. S.* in *Engliſh* Inches and Decimals, and the Parts of theſe in Vulgar Fractions, but are reduced to Decimals in the Tables. He uſed two Barometers and Thermometers. Thoſe marked I, are Mr *Haukſbee*'s, thoſe marked I I, *Florentine*. The coldeſt Day he ever obſerved, was *February* the 5th, 1726. It contains alſo the Winds, with their Strength, and Weather. Mr *Weidler* gives the Height of the Barometer three Times a Day, *N. S.* in *Paris* Inches and Lines, and the Parts of theſe in Vulgar Fractions; the Winds alſo, with their Strength, and the Weather, and Quantity of Rain, in Cubes and Lines, but at the End of each Quarter the Depth is given in *Paris* Inches and Lines. The Thermometer is Mr *Haukſbee*'s. There are ſome Aſtronomical Obſervations of Eclipſes, *&c.* He takes Notice, that an Occultation of *Venus* by the *Moon*, obſerved with a Teleſcope of 18 Feet, may ſerve to prove the *Moon* to have an Atmoſphere; for being then in it's Quadrature with the *Sun*, it appeared to loſe it's Cuſps, and become oval, when it came near the *Moon*. I have in theſe two Years made uſe of Mr *Haſius*'s Barometrical and Thermometrical Obſervations, being in the *O. S.* and *Engliſh* Meaſure, though the three laſt Months of 1730 are wanting. The Depth of Rain is taken from Mr *Weidler*, and reduced out of the *Paris* to *Engliſh* Meaſure, being ſuppoſed to be as 1068 to 1000, but is not reduced to the *Old Style*. Mr *Weidler* refers to his Diſſertation upon Meteorological Obſervations ſent to the Society. The Year 1730 he obſerves to have been more than had been known wet and cold, and the Sky very miſty.

That

That from *Padua*, by the Marquis *Poleni*, ſhews the Height of the Barometer once a Day, *O. S.* in *Engliſh* Inches and Decimals; the Winds, and ſometimes their Strength, and Weather. A particular Account of his Thermometer has been publiſhed formerly in the *Tranſactions*, and alſo his Obſervations upon his Diaries, containing in the whole ſix Years. The Depth of Rain is given both for the *Old* and *New Style*.

That from *Bengal*, by Mr *Bellamy*, Preacher to the Factory, has the Height of the Thermometer twice a Day, Morning and Evening; the Winds, with their Strength, and the Weather, for the Year 1730. The Medium of the Thermometer is taken from both the Evening and Morning Heights, the Difference there being very great in Proportion between Morning and Evening.

That from *Boſton* in *New England*, by *Paul Dudley*, Eſq; *F. R. S.* ſhews the Weather 3 Times a Day, and Wind once or twice. No Barometer or Thermometer.

There is one of the Year 1729, ſeems to be *Swediſh*; but finding neither the Author's Name nor Place, I have not inſerted it.

In the Year 1730, thoſe from *Crane-Court*, *Southwick*, *Kent*, *Hudickſvall*, *Oſtrogothia*, *Upſale*, *Svenaker*, *Lunden*, *Bettna*, *Wittemberg*, *Padua*, and *Boſton*, and continued in the ſame Manner. There is none from *Bygdea*. The *Abo* Obſervations for the Year 1730, by Mr *D. Sporing*, ſhew the Height of the Barometer twice a Day, in *Swediſh* Inches and Decimals, but the mean Heights are reduced to *Engliſh* in the Tables. They ſhew alſo the Winds and Weather, and in the laſt Column the *Auroræ Boreales*, which are frequent in moſt Months of the Year.

That from *Naples*, by *Cyrillus*, ſhews the Height of the Thermometer, which is Mr *Hauksbee*'s, once a Day. The Winds, with their Strength, and Weather, and Depth of Rain in *Neapolitan* Meaſures, 23 of which make a *London* Inch, and are reduced thereto in the Tables. The Barometrical Heights he has not ſet down, becauſe he found them not to agree with thoſe of former Years, which made him ſuſpect his Inſtrument to be out of Order; but as it appears he had removed his Habitation, it might be owing to it's being ſituated higher or lower than the former. An Eruption of *Veſuvius* happening, an Account is given of it, and of Damage done by Lightning, and alſo of the Seaſons, as to Fruitfulneſs and Healthineſs.

Note, In ſome of the Diaries, the Numbers ſhewing the decimal Parts of the Inches, are ſet down in ſingle Figures, without any Rule or Cypher to diſtinguiſh them from the Centeſimals, and in others the Centeſimals in like Manner; but it is eaſy to make a Judgment of the Author's Method by Conſideration of them.

Having given an Account of the Method and Contents of the ſeveral Diaries, I now proceed to the Tables extracted out of them. The Barometrical Table conſiſts of two Parts: The upper ſhews the mean Height

Height of the Barometer, taken in the Method propoſed formerly by Dr *Jurin*, for every Month throughout the Year, for each Place; and in each Column the higheſt Month is marked with an *h*, the loweſt with an *l*, to make them more obſervable to the Eye. At the Bottom, the Mean of the whole Year is ſet down for each Place. At the Foot of this Table is another, ſhewing the greateſt Aſcent and Deſcent of the *Mercury* in that Year, with the particular Day of each, the Difference of which is the Range: Which Circumſtance Dr *Derham*, and other Obſervers, have uſed generally to take Notice of.

Next follow the Table of the monthly Thermometrical Heights, extracted in Dr *Jurin*'s Method alſo, in every Place where the Society's Inſtruments were uſed; and at the Bottom the Mean of the whole Year, and alſo the hotteſt and coldeſt Day in each Place. In the laſt Place, the Tables of the Depth of Rain, where it is contained in the Diaries.

I choſe to put each of theſe Matters in ſeparate Tables, that the Eye may be able to take a View of the whole, and compare the State of each Place with the others, as to each Particular, with leſs Confuſion, as alſo becauſe ſeveral of the Diaries have nothing upon one or more of theſe Heads.

Note, The mean Heights of both Barometer and Thermometer are extracted only from the Morning Obſervations, ſome of the Diaries containing no more; and judging it ſufficient to the preſent Deſign of theſe Tables, except in the mean Heights of the Thermometer at *Bengal*, which are taken from both Morning and Evening Obſervations.

A Table

A Table of the monthly mean Barometrical Heights, and also of the greatest Ascents and Descents of the Mercury *observed in several Places, in the Year* 1729, *in Inches and Decimals.*

A.

1729.	*Crane-Court, London.* Lat. 51° 31	*Southwick* in *Northampt.* Lat. 52 54	In *Kent.* Lat. 51	*Hudicksvall* in *Sweden.* Lat. 62	*Ostrogothia* in *Sweden.* Lat. 56	*Upsale* in *Sweden,* Lat. 59 48
January	30 08	29 70	29 41 h	29 49	29 20 l	29 43 l
February	02	66	37	30 02	576	92
March	29 93	54	37	29 63	27	55
April	93	60	26	30 04 h	62 h	30 16 h
May	95	57	29	29 82	38	29 71
June	30 07	69	36	86	35	74
July	29 97	64	28	69	20 l	60
August	30 09 h	72 h	38	78	35	65
September	29 69	42	09	90	42	81
October	83	52	09	55	32	54
November	61 l	32 l	28 94 l	45 l	25	54
December	83	52	29 25	75	52	79
Mean of the whole Year.	29 91	29 575	29 ,257	29 ,748	29 371	29 73
☿ Highest	30 55 *Feb.* 26	30 11 *Feb.* 26.	29 90 *Feb.* 26.	30 60 *Feb.* 23.	30 35 *Feb.* 27.	30 59 *Feb.* 27.
Lowest	28 75 *Nov.* 25.	28 48 *Nov.* 25.	28 16 *Nov.* 25.	28 43 *Oct.* 12.	28 15 *Jan.* 20.	28 70 *Jan.* 18.
Diffe.	1 80	1 63	1 74	2 17	2 20	1 89

C.

B.

1729.	*Svenaker* in *Sweden.* Lat. 58° 10	*Lunden* in *Sweden.* Lat. 55 42	*Bygdea* in *Sweden.* Lat. 63 40	*Bettna* in *Sweden.*	*Wittemburg* in *Saxony,* by Mr *Hasius.* Lat 52	*Padua* in *Italy.* Lat. 45 15
January	29 44	29 42	29 18	29 77	29 83 h	29 74
February	62	54	76	30 18 h	778	725
March	28	38	41	29 84	65	66
April	65 h	57	82 h	30 17	64	85
May	44	48	61	29 89	35	67
June	56	59 h	63	88	77	74
July	43	44	50	72 l	34 l	63 l
August	52	57	57	84	79	79
September	51	44	76	92	65	65
October	37	46	33 l	76	67	75
November	18 l	33 l		75	51	64
December	53	52		99	74	89 h
Mean of the whole Year.	29 46	29 47	29 ,557	29 892	29 643	29 727
☿ Highest	30 41 *Feb.* 28.	30 ,40 *Feb.* 27.	30 36 *Feb.* 23.	30 70 *Feb.* 18.	30 50 *Jan.* 7.	30 30 *Dec.* 20.
Lowest	28 31 *Jan.* 18.	28 23 *Jan.* 18.	28 18 *Oct.* 12.	28 75 *Oct.* 12.	28 95 *Nov.* 27.	28 90 *Nov.* 10.
Differ.	2 10	2 17	2 18	1 95	1 55	1 40

D.

A Table

Thermometrical Heights and Depth of Rain in 1729.

A Table of the monthly mean Thermometrical Heights in ſeveral Places in the Year 1729.

1729.	*Crane-Court.*	*Southwick.*	*Upſale.*	*Wittemberg.*
January	67 ,3	70	80	70 ,9
February	69 ,2	74	82 ,7	67 ,5
March	60 ,8	69	70 ,6	56 ,3
April	55 ,2	61	58 ,9	51 ,6
May	42 ,6	53	48 ,5	36 ,0
June	34 ,9	43	37 ,3	30 ,2
July	33 ,1	42	35 ,1	29 ,0
Auguſt	33 ,8	43	40 ,4	29 ,65
September	38 ,6	46	47 ,1	37 ,6
October	51 ,1	57	60 ,8	50 ,2
November	56 ,8	60	66 ,3	59 ,6
December	58 ,8	63	71 ,4	70 ,6
Mean of the Year.	50 ,1	56 ,7	57 ,6	49 ,09
Thermom.				
Higheſt	12 ,5 *June* 10.	13 *June* 10	22 5 *June* 9.	14 ,75 *May* 23
Loweſt	80 ,,5 *Jan.* 7.	88 *Jan.* 4	97 *Jan.* 5.	95 ,0 *Jan.* 1.

A Table of the Depth of Rain which fell in ſeveral Places in the Year 1729, *in Inches and Decimals.*

1729.	*Crane-Court.*	*South-wick.*	*Kent.*	*Oſtrogothia.*	*Upſale.*	*Wittemberg, Stylo Novo.*	*Padua.*
Jan.	,739	,16	,499	,830	1 ,153		1 ,085
Feb.	,785	,48	1 ,069	1 ,050	1 ,027		1 ,245
March	1 ,125	1 ,31	1 ,286	,600	,826	,48	2 ,902
April	1 ,600	1 ,10	2 ,197	,005	,000	,905	2 ,768
May	1 ,515	1 ,55	2 ,216	3 ,865	,875	,94	2 ,631
June	1 ,200	0 ,83	,730	2 ,930	2 ,450	,815	3 ,134
July	1 ,04	2 ,26	2 ,153	1 ,615	2 ,578	1 ,31	4 ,526
Auguſt	3 ,04	2 ,44	2 ,533	1 ,405	,747	1 ,365	,578
Septem.	3 ,505	5 ,32	2 ,343	2 ,940	2 ,687	,78	3 ,267
October	1 ,420	2 ,20	2 ,218	1 ,050	,139	1 ,43	6 ,294
Novem	2 ,425	4 ,18	4 ,334	2 ,150	,855	1 ,305	4 ,186
Decem.	1 ,950	1 ,68	1 ,947	3 ,040	1 ,140	1 ,295	2 ,804
Total	20 ,344	23 ,51	23 ,525	21 ,480	14 ,477	11 ,625	35 ,423

A Table

Barometrical Heights in the Year 1730.

A Table of the monthly mean Barometrical Heights, and alſo of the greateſt Aſcents and Deſcents of the Mercury *obſerved in ſeveral Places, in the Year* 1730, *in Inches and Decimals.*

A.

1730.	*Crane-Court, London.* Lat. 51° 31	*Southwick* in *Northampt.* Lat. 52 54	In *Kent.* Lat. 51	*Hudickſvall* in *Sweden.* Lat. 62	*Oſtrogothia* in *Sweden.* Lat. 56	*Upſale* in *Sweden.* Lat. 59 48
January	30 ,04	29 ,79	29 51 h	29 61	29 50	29 66
February	29 ,61	39	06	50 l	29	60
March	,52 l	34 l	03 l	77	45	79
April	90	66	37	77	52	77
May	,76	55	15	68	58	72
June	,83	60	24	75	35	75
July	,84	61	31	82	31	78
Auguſt	,94	70	39	75	38	74
September	,90	34 l	37	75	44	75
October	68	49		96 h	64	93 h
November	79	55		50 l	26 l	56 l
December	30 ,09 h	83 h		84	68 h	89
Mean of the whole Year.	29 ,825	29 ,57	29 ,27	29 ,725	29 ,455	29 ,745
☿ Higheſt	30,35 *Dec.* 1. 13.	30,30 *Jan.* 10.	30,01 *Jan.* 10.	30,52 *Dec.* 1.	30,40 *Dec.* 1	30,71 *Dec.* 1.
Loweſt	28,70 *Mar.* 8.	28,53 *Mar.* 8.	28,28 *Mar.* 8.	28,70 *Dec.* 10.	28,45 *Jan.* 18.	28.90 *Dec.* 10.
Differ.	1,65	1,77	1,73	1,82	1,95	1,81

C.

B.

1730.	*Svenaker* in *Sweden.* Lat. 58° 10	*Lunden* in *Sweden.* Lat. 55 42	*Bettna* in *Sweden.* Lat. 58 49	*Abo* in *Finland* Lat. 60 40	*Wittemberg* in *Saxony*, by Mr *Haſius.* Lat 52	*Padua* in *Italy.* Lat. 45 15
January	29 39 l	29 57	29 96	29 68	29 823 h	29 88
February	46	23 l	81	435	4281	55
March	42	34	97	61	48	46 l
April	59 h	56	30 03	705	677	69
May	54	46	29 89	55	99	67
June	53	55	89	60	667	67
July	40	51	87	665	671	69
Auguſt	53	59	89	56	776	80
September	48	57	30 04	30 05 h	80	82
October	56	61	11	29 76		72
November	46	30	29 74 l	355 l		76
December	43	65 h	30 12 h	68		96 h
Mean of the whole Year	29 ,48	29 ,495	29 ,943	29 ,637	29 ,701	29 ,705
☿ Higheſt	30,42 *Dec.* 1.	30,22 *Dec.* 1. 13	30,98 *Dec.* 1	31,20 *Dec.* 1.	30,37 *Jan.* 30.	30,40 *Dec.* 26.
Loweſt	28,43 *Dec.* 10.	28,61 *Dec.* 31.	28,96 *Dec.* 10.	28,64 *Nov.* 23.	29,00 *Feb.* 27.	28,08 *Feb.* 27.
Differ.	1,99	1,61	2,02	1,56	1,37	1,42

D.

Thermometrical Heights, and Depth of Rain in 1730.

A Table of the monthly mean Thermometrical Heights in ſeveral Places in the Year 1730.

1730.	*Crane-Court.*	*Southwick.*	*Upſale.*	*Wittemberg.*	*Naples.*	*Bengal.*
Jan.	67 9	69	74	72	50 5	30
Feb.	63	68	72	67	48 3	22 ,4
March	56 ,27	62	74 5	60	40	6 ,9
April	50 2	58	56 2	48	40	4 ,0
May	41 30	49	42 4	35	40	5 ,2
June	37 7	46	29 9	29	19 5	5 ,3
July	35 22	42	21 90	26	16 7	8 ,8
Auguſt	33 8	44	34 05	29	14 2	9 ,4
Septem.	39 8	47	50 21	40	22 6	6 ,2
October	50 1	55	62 20		29	14 ,4
Novem.	55 5	59	72 27		40 1	23 ,4
Decem.	49 51	70	73 10		49 9	32 ,3
Mean	48 35	55	55 22		34 3	14 ,2
Higheſt	10. 5. *July* 25.	16 *July* 24	9. 1. *July* 27.	11. *July* 25.	9. *Aug.* 17. 0 *Jan.*	
Loweſt	77. 5. *Jan.* 7.	83 *Dec.* 14.	86. 7. *Mar.* 16.	81. 50. *Jan.* 15.	60. *Jan.* 10. 40 *Dec.*	

A Table of the Depth of Rain which fell in ſeveral Places in the Year 1730, *in Inches and Decimals.*

1730.	*Crane-Court.*	*South-wick.*	*Kent.*	*Oſtro-gothia.*	*Upſale.*	*Wittemberg, Stylo Novo.*	*Naples.*	*Padua.*
Jan.	450	45	624	705	164	78	3 89	112
Feb.	1 230	1 53	2 054	870	412	1 68	1 434	2 906
March	3 595	2 61	4 067	2 730	1 983	2 86	739	4 592
April	,670	84	985	605	165	1 98	2 39	1 638
May	1 755	2 5	1 805	2 260	4 120	3 23	1 39	4 467
June	3 755	3 39	2 876	1 535	755	2 31	1 00	6 505
July	2 390	1 93	2 598	2 445	1 904	2 01	2 173	2 339
Auguſt	020	0 85	131	505	525	3 07	0 0	4 269
Septem.	2 100	1 65	2 043	3 140	1 579	2 16	2 67	1 090
October	2 460	2 94	2 424	1 670	1 103	61	2 52	5 254
Novem	1 570	1 93	2 065	915	831	2 97	2 91	0 534
Decem.	1 500	81	1 322	890	1 105	2 09	3 22	0 894
Total	21 ,495	21 ,0	22 ,924	18 ,360	14 ,646	25 ,75	24 ,336	34 ,300

Firſt, I obſerve upon the Barometrical Tables of theſe two Years, that they confirm former Remarks made by Dr *Derham* and others, of the Conſent of the Barometers in Places at a good Diſtance from each other. Not only the monthly mean Heights agree in the three Diaries of theſe two Years here in *England*, but alſo the greateſt Aſcent and Deſcent of the *Mercury* happen commonly on the ſame Day, and the Barometers have been found to agree in their Motions to an Hour, ſo far aſunder as *Townely* in *Lancaſhire*, and *Greenwich* near *London*, which is near 160 Miles, although that might be partly accidental. The Barometer at *Crane-Court* and *Southwick*, diſtant about 55 Miles, being compared, ſeem very ſeldom to vary from their mean Difference above $\frac{1}{10}$ and $\frac{1}{2}$ each Way; at *Southwick* and *Kent* ſomething more. From whence it might be expected, that the Weather ſhould be much the ſame in all theſe Places; which nevertheleſs ſeems not to agree with Accounts in ſome Years from different Parts in this Iſland, not very far diſtant: And I myſelf have obſerved ſometimes Clouds to lie in one Part of the Horizon for a great Part of a Day, which have diſcharged a large Quantity of Rain in Places not far off, while the Place, where I have been, has all the while enjoyed fair Weather, and *vice verſa*. Whence it appears, that the Barometrical Alterations of the Air extend farther than their Effects, as to the Production of Rain, at thoſe Times. Comparing the Diaries of *Crane-Court* and *Upſale*, I find the Barometers vary from their mean Difference an Inch and half each Way; *Crane-Court* and *Padua* as much, or more, and often go a-pace quite contrary Ways at the ſame Time, and their monthly Differences are alſo very variable, ſo that their Agreement at any Time ſeems to be but accidental.

Secondly, I obſerve, that the Deſcents of the *Mercury* below the mean Heights of each Place, taken in this Way of Dr *Jurin*'s, are generally much greater than the Aſcents of it above; and there are alſo other extraordinary Deſcents of the *Mercury* in every Year of the ſame Kind. The Reaſon I take to be, becauſe the Expanſion of the Air, whereby it becomes lighter in ſome one Place, being the Original of the Alterations in the Atmoſphere, it's Effects by Condenſation or Accumulation of the Air in the Places round about will be more diſperſed, and therefore leſs ſenſible.

Thirdly, The Variation or Range is greater the farther North, as has been heretofore obſerved, and appears in theſe Tables, in which I have put the Latitude of each Place; and likewiſe it is greater generally in the Winter than Summer Months. The Sum of the Motion of the *Mercury* upwards and downwards, taken from the *Berlin* wandering Line, with a Pair of Compaſſes, in the Year 1726, amounts to about 76 Inches, which gives $5\frac{1}{3}$ for a Month, and about 0,21 for each Day. But the Barometer is by much moſt ſteady in the Summer.

Fourthly, The mean Height of the Barometer hath already been applied to determine the reſpective Heights of Places, and alſo the abſolute Height above the Surface of the Sea. Dr *Scheuchzer*, in his Tables,

ſuppoſes, from Mr *Marriot*, the mean Height at the Surface of the Sea to be 28^{II} 1^{III} *Paris* Meaſure, which reduced to *Engliſh*, gives 29 Inches, 993. This agrees very well with a Diary communicated to the Society, containing 10 Months of the Year 1723, and *Jan.* 1724; the Author of which found by Experiment, that in the Place where his Barometer was kept, the *Mercury* ſtood $\frac{1}{10}$ and $\frac{1}{2}$ higher than at the Surface of the Sea, which was not far from his Habitation. The mean Height of the Barometer for thoſe 10 Months (leaving out the *Jan.* following, which ſeems to be a very irregular Month) I find to be 29, 825, to which adding $\frac{1}{10}$ $\frac{1}{2}$, it will give the mean Height at the Surface of the Sea 29,975; ſo the Difference between theſe is only ,018, and therefore probably may be near the Truth, but may hereafter be more exactly determined by Experiments. Then allowing about 90 Feet, or rather leſs, for each 10th of an Inch in Height of the *Mercury* in ſmaller Altitudes, or in greater, according to the Tables calculated for that Purpoſe, by Dr *Scheuchzer* and Dr *Nettleton*, and publiſhed in the *Tranſactions* of this Society, *l. c.* & N° 388. you will have the Height of each Place pretty near, provided the Obſervations be carefully made, and continued for a ſufficient Time; for the yearly mean Heights in one of the Places in theſe Tables appear to differ near $\frac{1}{10}$ of an Inch in theſe two Years; and in moſt of them, the laſt of theſe two Years exceeds the firſt, two or three Hundreths: The Barometer alſo ought not to be removed to a lower or higher Place.

Upon the Thermometrical Tables, and thoſe of the Rain, I have at preſent no Remarks to make, but what are obvious on firſt Sight; only that the Thermometers agree, eſpecially as to the hotteſt Days in the Year, more than might be expected from Places at ſuch a Diſtance.

The Winds are of ſo uncertain and variable a Nature, that they require a more than ordinary Care and Diligence in making the Obſervations, and a great Length of Time, and Compariſon of a vaſt Number of them, before any Thing can be deduced more than is commonly known; and therefore I ſhall not endeavour to do it at this Time, but only give this Hint, that if the Obſervers would take particular Notice, in great Storms, of the Time when the *Mercury* firſt begins to riſe, whether before, or after, or in the very Height of it, it might be a Direction to judge when an Abatement or Increaſe of it might be expected, (if any regular Order ſhould be found therein) which might be ſerviceable on ſome Occaſions. But if any Attempt ſhould be made to lay down any Thing certain concerning the Riſe and Progreſs of the variable Winds, it will appear, by conſidering the Cauſe of the Trade-Winds, that for the ſame Cauſe the Motion of the Air will not be naturally in a great Circle, for any great Space, upon the Surface of the Earth any where, unleſs in the Equator itſelf, but in ſome other Line; and, in general, all Winds, as they come nearer the Equator, will become more and more eaſterly, and as they recede from it, more and more weſterly, unleſs ſome other Cauſes intervene.

Theſe

Theſe are all the Obſervations I have at preſent to offer on this Subject, which I ſhould have been glad if they had been more material, and anſwerable to the Labour beſtowed by the curious Obſervers; but they may aſſure themſelves, that the Diaries communicated to the Society will be carefully preſerved, for the Peruſal of thoſe who may be inclined to enquire farther into this Part of Nature; and perhaps by the Continuance of this Method, in Proceſs of Time, a Diſcovery may be made of ſome regular Courſe in theſe Things, which may be of Uſe.

2. The Diaries that continue throughout the ſaid 5 Years, are only thoſe kept at *Crane-Court*, *Southwick*, and *Coventry*. The *Kentiſh* Diary for the Year 1731 is wanting, and ends with the Year 1734. I have, in my former Account of the Years 1729 and 1730, given an Account of the Method and Contents of the two Firſt. Mr *Henry Beighton*'s from *Griff* near *Coventry*, contains the Height of the Barometer at ſeveral times of the Day, in Inches and Decimals, and the Weather. That from *Upſal* by Mr *Celſius*, from *Hudickſval* by Mr *Broman*, and from *Abo* by Mr *Sporing*, go no farther than the Year 1731; for which Year there is alſo one from *Lunden* by an Author whoſe Name I do not find; for it appears not to be Mr *Conrad Quenſel*'s, whoſe end in the Year 1730, from the ſame Place: It contains Obſervations on the Barometer twice a Day, in *Swediſh* Meaſure, which I have reduced to *Engliſh*; the Wind and Thermometer, which is a particular one of his own.

An Account and Abſtract of the Meteorological Obſervations communicated to the Royal Society, *for the Years* 1731, 1732, 1733, 1734 *and* 1735. *By the ſame.* No. 466. p. 243. *Read* Dec. 9. 1742.

Mr *Weidler*'s Diary from *Wittemberg* continues to the End of the Year 1734. In the Year 1732, he alters his Method of the Barometrical Heights, from *Paris* to *London* Meaſure, and the Days of the Month from the *New Style* to the *Old* one, to make them the better correſpond with our Obſervations. He gives a very accurate Account of the *Phænomena* of ſeveral Northern Lights in the Ends of the Years 1731 and 1733, and Beginning of the Year 1734. His Diaries alſo contain ſome few Aſtronomical Obſervations, and extraordinary Occurrences.

Captain *Chriſtopher Middleton*'s Journal of his Voyage to *Hudſon's-Bay* is publiſhed already. The *Naples* Diary by Dr *Cyrillus* ends in the Year 1732, and alſo that from *New-England* by Mr *Dudley*.

For the Year 1734, that from Dr *Pack*, at *Canterbury*, exhibits in one View, by a Table for every Month of the Year, in the firſt Column, the Quantity of Rain, and the Evaporation: In the ſecond, third, and fourth, the greateſt and leaſt and middle Heights of the Barometer Thermometer, and Hygrometer: In the fifth, the Meteors, by Variety of Marks, which he gives an Explanation of: In the ſixth, the Direction and Strength of the Winds. He gives alſo a Deſcription of the Inſtruments he invented, and made uſe of, for Obſervation of the Quantity of Rain and Evaporation, and the Hygrometer, with a Draught of each. For *Jan.* there is a particular Table, containing great

Variety

Variety of Obſervations for every Day of that Month. The Thermometer is peculiar to himſelf, as far as I know; and he gives no Rule to reduce it to the Standard. There is a Letter of his, relating to a Chart of the Levels of *Kent*, which, he thinks, are ſo contrived as to cauſe a Circulation of Air from the Sea, which is of great Uſe. Mr *Forth*'s Diary, at large, from *Darlington*, begins in the Year 1737; but he has given an Abſtract for the 3 preceding Years: In which the greateſt, leaſt and middle Height of the Barometer is given for every Month; which Mean, upon Examination, I take to be found in the way uſed in theſe Tables, and therefore I have put them in as ſuch. By a Letter of his it appears, his Thermometer ſtands at 45°, when Mr *Hawkſbee*'s ſtands at 33, which is 12 Difference; and, I ſuppoſe, he means they differ ſo much throughout the Scale; ſo by that Rule I have reduced his Obſervations to the Table. *Quere*, At what Time of the Day the Obſervations were made, and where the Thermometer was placed; for the mean Heights differ but little from thoſe at *London*, as he obſerves in his Letter. There is an Extract of a Letter from *Signor Didacus de Revillas* to Dr *Mortimer*, containing an Account of the Rain that fell at *Rome*, beginning with *Auguſt* 1734, and ending with *July* 1735, in *Paris* Meaſure, which I have reduced to *Engliſh*.

Marquis *Poleni*'s Diaries, at large, from *Padua*, end in the Year 1730; but he ſent an Abſtract of his Obſervations for the Six following Years, which was publiſhed in the *Philoſophical Tranſactions* N°. 448*. in which the Account of the Depth of Rain being entire, I have inſerted it in the Table, for the readier comparing it with other Places.

Theſe are all the Manuſcript Obſervations communicated to the *Royal Society*, relating to *Meteorological Obſervations*. I have added the Obſervations of the Barometer, Thermometer, and Rain, at *Edinburgh*, from the four Volumes of Medical Eſſays; and Mr *Dopplemaier*'s Barometrical Obſervations, from the printed ones at *Norimberg*, to make the Tables as general as I could. The Tables are drawn up in the ſame manner as thoſe for the Years 1729 and 1730; and from them various Obſervations and Compariſons may be made, in the ſame manner as has been done by ſeveral Hands heretofore, particularly, Dr *Plot*, Dr *Derham*, Mr *Locke*, Marquis *Poleni*, and others, as appears in the *Tranſactions* of this *Society*; and many more ſuch Obſervations may be added, by thoſe that are curious in theſe things, at their Pleaſure.

* See §. LVIII. of this Chapter.

A Table

A Table *of the monthly mean Heights, and also of the greatest Ascents and Descents of the* Barometer, *observed in several Places, and communicated to the* Royal Society, *for the Year* 1731, *in Inches and Decimals.*

1731.	*Crane-Court, London.* Lat. 51° 31′	*Southwick* in *Northamptonsh.* Lat. 52 31	*Coventry* in *Warwickshire.* Lat. 52 34	*Upsal* in *Sweden.* Lat. 59 48	*Hudicksval* in *Sweden.* Lat. 62°
January	29 ,83	29 ,61	29 ,44	29 ,71	29 ,69
February	78	57	31	98	74
March	30 20	92	72	71	99
April	29 71	51	31	79	86
May	30 00	72	52	79	79
June	29 92	66	48	66	71
July	95	72	51	68	76
August	86	65	48	85	92
September	96	70	49	65	59
October	93	67	47	84	82
November	77	54	33	61	56
December	88	61	39	66	88
Mean of the whole Year	29 ,89	29 ,658	29 ,45	29 ,74	29 ,77
☿ Highest	30 ,50 *Mar.* 7.	30 ,11 *May* 30	29 ,96 *May* 31	30 ,48 *Oct.* 29	30 ,52 *Dec.* 23
Lowest	29 ,00 *Feb.* 12.	28 ,82 *Feb.* 12	28 ,59 *Feb.* 12	28 ,66 *Dec.* 6.	28 ,59 *Dec.* 6.
Differ.	1 ,5	1 ,29	1 ,37	1 ,82	1 ,93

1731.	*Lunden* in *Sweden.* Lat. 59° 48′	*Abo* in *Findland.* Lat. 60 40	*Wittemberg* in *Saxony.* Lat. 52°	*Naples* in *Italy.* Lat. 41	*Edinburgh* in *Scotland.* Lat. 56 20
January	29 ,37	29 ,54	29 ,48	29 ,09	
February	43	52	60	11	
March	57	45	70	30	
April	43	55	48	03	
May	65	58	86	14	
June	51	48	73	29	29 05
July	53	48	77	01	07
August	48	66	71	03	07
September	64	47	78	17	06
October	59	28 87	82	06	03
November	34	29 21	47	14	08
December	29	46	77	32	05
Mean of the whole Year	29 ,48	29 ,44	29 ,66	29 ,14	29 ,58
☿ Highest	30 ,91 *Jan.* 10.	31 ,12 *Dec.* 21	30 ,21 *June* 1	29 ,4 *Sæpe.*	
Lowest	29 ,1 *Jan.* 29	28 ,90 *Dec.* 7.	28 ,66 *Jan.* 29	28 ,76 *Jan.* 29	
Differ.	1 ,81				

A Table of the monthly mean Heights, and also of the greatest Ascents and Descents of the Thermometer, observed in several Places in the Year 1731, *and communicated to the* Royal Society.

1731.	*Crane-Court.*	*Southwick.*	*Upsal.*	*Abo.*	*Wittemberg*	*Naples.*	*Edinburgh.*
January	70 ,8	72	76 ,8	93 ,3	82 ,4	54 ,5	
February	64 4	66 5	71 1	98 5	79 9	45 9	
March	57 2	57 5	66 7	91 5	72 2	45 4	
April	56 2	57	60 1	82	62 9	38 3	
May	39 9	42	43 2	68	46	26 6	
June	36 1	38	38 3	50 5	43 7	17 7	48
July	32 1	36	37 4	50	41 3	12 7	41
August	33 1	37	40 3	49	39 7	14 3	45
September	38 4	42	47 2	61 5	48 9	18 9	49
October	46 6	49	56 3	73	60 7	26 3	57
November	59 9	59 5	65 7	83	66 4	36 9	69
December	63 1	63 5	72 9	90	77 9	49 9	74
Mean of the whole Year	49 ,8	52 ,0	56 ,3	74 ,1	60 ,1	32 ,3	
Thermom.							
Highest	8 *July* 31.	10 *June* 31.	16 *Aug.* 2.	20 *June* 21.	26 *June* 27	5 *June* 20.	28 *July* 4.
Lowest	82 *Jan.* 31.	80 *Jan.* 8.	91. 6 *Jan.* 31.	120 *Jan.* 31.	108 *Jan.* 13.	60 *Jan.* 23.	0[illegible] *Nov.* 18
Difference	74	79	75	100	82	55	67

A Table, in Inches and Decimals, of the Depth of Rain which fell in several Places, in the Year 1731, *communicated to the* Royal Society.

1731.	*Crane-Court.*	*South-wick.*	*Upsal.*	*Wittem-berg, N.S.*	*Naples.*	*Padua.*	*Edin-burgh.*
January	,125	,81	,774	1 ,557	2 ,60	2 ,546	
February	82	1 04	330	934	2 8	3 093	
March	05	15	2 544	1 775	478	976	
April	1 26	2 07	587	801	2 478	3 434	
May	39	33	669	2 610	1 130	602	
June	2 30	3 38	3 074	1 616	870	4 253	2 ,05
July	2 085	1 65	2 681	1 513	347	3 402	54
August	1 73	1 54	1 402	222	3 239	7 372	1 85
September	55	1 47	1 913	1 898	213	2 216	2 02
October	1 36	1 34	1 171	1 068	3 0	4 354	1 47
November	1 53	1 49	460	2 699	4 04	1 653	1 42
December	1 40	2 30	397	1 927	6 76	306	3 12
Total	13 ,60	17 ,57	16 ,002	18 ,620	27 ,955	34, 207	

The

The Barometrical Table for the Year 1732.

1732.	*Crane-Court.*	*Southwick.*	*Kent.* Lat. 51.	*Coventry.*	*Wittemberg.*	*Naples.*	*Edinburgh.*
January	29 ,75	29 ,54	29 ,53	29 ,27	29 ,54	29 ,08	29 ,3
February	87	65	62	38	53	11	4
March	76	57	52	33	35	14	6
April	71	52	04	27	43	28 95	5
May	70	50	36	26	54	96	5
June	96	71	71	52	54	97	8
July	91	65	55	46	54	29 38	7
August	95	70	66	52	64	03	9
September	91	63	70	47	64	22	6
October	58	68	27	15	39	10	3
November	30 00	75	89	88	47	24	8
December	29 74	47	48	28	52	10	8
Mean of the whol. Year	29 ,82	29 ,627	29 ,53	29 ,37	29 ,51	29 ,1	29 ,60
☿ Higheſt	30 ,5 *Feb.* 14.	30 ,13 *Nov.* 24.	30 ,29 *Sept.* 25.	29 ,96 *Nov.* 25.	30 ,25 *Dec.* 9	29 ,40 *Jan. ſæpe*	31 ,0 *Aug.* 28.
Loweſt	29 ,0 *Dec.* 31.	8 ,70 *Dec.* 30	28 ,32 *April* 5.	28 ,54 *Dec.* 30.	28 ,729 *Nov.* 17.	28 ,82 *May* 28.	28 ,2 *Nov.* 18.
Differ.	1 ,5	1 ,43	1 ,97	1 ,42	1 ,524	,58	2 ,8

The Thermometrical Table for the Year 1732.

1732.	*Crane-Court.*	*Southwick.*	*Wittemberg.*	*Naples.*	*Edinburgh.*
January	66 ,1	67 ,5	86 ,5	53 ,5	75
February	53 8	57	67 4	43	65 ,5
March	57	58 5	66 8	39 8	65 5
April	47 9	52	53 7	34 3	63
May	45 3	48 5	42 2	22 4	54
June	37 6	40	38 8	19 2	41 5
July	32 8	36 5	35 3	8 3	43
August	36	40	41 6	15 9	46
September	42	44	53 9	23	54
October	47 8	51	58 9	24 5	61
November	62 1	64 5	78 8	42	72
December	64 2	66	84 5	49 2	73 5
Mean of the whole Year.	49 ,3	52	58 ,8	31 ,3	59 ,5
Thermom. Higheſt	19 *Aug.* 20.	20 *Aug.* 13.	3,5 *July* 16.	4 *July* 17.	28 *July* 7.
Loweſt	80 *Dec.* 12.	88 *Dec.* 11.	113 *Dec.* 11.	57 *Jan. Sæpe.*	89 *Dec.* 14.
Difference	61	68	109,5	53	61

A Table for the Depth of Rain for the Year 1732.

1732.	*Crane-Court.*	*Southwick.*	*Kent.*	*Wittemberg.*	*Naples.*	*Padua.*	*Edinburgh.*
January	,525	,9	,537	,399	5 ,70	2 ,129	1 ,28
February	1 90	1 2	2 276	1 464	52	1 959	2 409
March	1 15	1 4	1 216	917	33	2 765	79
April	2 765	1 2	1 310	2 514	1 30	5 432	3 1
May	3 2	3 4	3 494	1 864	434	1864	4 62
June	1 05	6	803	2 308	2 08	2 872	1 19
July	1 13	1 8	1 527	2 929	1 20	1 585	3 19
Auguſt	1 5	1 7	931	1 390	1 13	3 112	1 62
September	1 14	7	825	1 833	78	089	0 00
October	2 39	3 7	3 295	1 346	4 70	9 164	2 52
November	1 2	1 2	1 269	1 435	3 34	957	41
December	1 705	2 6	1 471	1 524	4 82	3 528	3 61
Total.	19 ,655	20 ,5	18 ,954	19 ,923	26 ,334	35 ,456	24 82

The Barometrical Table for the Year 1733.

1733.	*Crane-Court.*	*Southwick.*	*Kent.*	*Coventry.*	*Wittemberg.*	*Edinburgh.*
January	29 ,96	29 ,68	29 ,65	29 ,43	29 ,78	29 ,8
February	81	55	54	31	67	6
March	65	43	35	21	49	6
April	85	65	54	43	62	7
May	89	70	80	50	57	8
June	91	67	68	44	68	8
July	90	67	51	46	65	7
Auguſt	81	56	43	36	55	6
September	89	62	53	41	99	6
October	97	72	30 04	48	70	8
November	30 01	75	06	50	74	7
December	29 85	53	29 66	36	68	5
Mean of the whole Year.	29 ,87	29 ,63	29 ,65	29 ,40	29 ,67	29 ,68
Higheſt	30 ,55 *Oct.* 19.	30 ,17 *Oct.* 19.	30 ,52 *Oct.* 19.	30 ,1 *Oct.* 18.	30,68 *Sept.* 22.	31 ,0 *Jan.* 18.
Loweſt	28 ,95 *Mar.* 22.	28 ,69 *Jan.* 1.	28 ,53 *Sept.* 25.	28 ,5 *Feb.* 2.	28 ,62 *Nov.* 12.	28 ,4 *Sept.* 26.
Differ.	1 ,6	1 ,48	1 ,99	1 ,51	2 ,6	2 ,6

The

The Thermometrical Table for the Year 1733.

1733.	*Crane-Court.*	*Southwick.*	*Wittemberg.*	*Edinburgh.*
January	60 ,1	61 ,5	78 ,8	70
February	59	60	70	68 ,5
March	59	59 5	68 6	68 5
April	52 8	51 5	53 6	59
May	45 3	47	50 5	51
June	35 2	36	38 3	41
July	28 5	32 5	36 1	38
August	35 9	39 5	41 7	47
September	45 4	48	57 2	54
October	53 4	56	72 5	62 5
November	56	58	68 7	62 5
December	54	55 5	68 9	64
Mean of the whole Year	47 ,9	50	50 ,4	57
Therm. Higheſt	16 *June* 26.	10 *June* 25.	3 ,5 *June* 28.	28 *June* 26.
Loweſt	72 ,5 *Jan.* 21.	85 *Jan.* 22.	99 *Jan.* 19.	86 ,5 *Jan.* 21.
Differ.	56	75	95 ,5	58 ,5

A Table of the Depth of Rain for the Year 1733.

1733.	*Crane-Court.*	*Southwick.*	*Kent.*	*Wittemberg.*	*Padua.*	*Edinburgh.*
January	,69	1 ,0	1 ,235	,562	1 ,855	1 ,37
February	1 16	1 4	1 925	562	405	2 52
March	2 145	2 2	2 161	1 183	5 642	2 63
April	1 70	1	1 815	621	3 816	81
May	55	0 05	216	1 642	5 33	08
June	2 65	2	1 742	2 308	2 712	2 13
July	1 54	2 2	979	1 45	3 874	63
August	3 225	3 6	3 354	2 308	3 679	2 67
September	1 37	1 4	1 499	517	589	1 83
October	91	6	790	828	2 788	1 08
November	52	5	1 081	3 61	382	32
December	2 44	1 7	3 201	3 151	1 065	3 62
Total	18 ,9	17 ,5	19 ,998	18 ,742	32 ,137	19 ,69

The Barometrical Table for the Year 1734.

1734.	*Crane-Court.*	*Southwick.*	*Kent.*	*Coventry.*
January	30 ,06	29 ,80	29 ,88	29 ,53
February	29 85	60	69	39
March	76	52	61	28 99
April	95	69	84	29 49
May	82	54	52	33
June	87	55	65	44
July	87	63	65	44
Auguſt	77	57	60	37
September	30 04	56	65	37
October	00	47	46	30
November	38	74	79	53
December	29 76	22	24	02
Mean of the whole Year	29 ,92	29 ,58	29 ,63	29 ,43
☿ Higheſt	30 ,75 *Nov.* 28.	30 ,25 *Jan.* 12	30 ,34 *Jan.* 11.	30 ,05 *Jan.* 12.
Loweſt	28 ,7 *Dec.* 15.	28 ,10 *Dec.* 15.	28 ,19 *Dec.* 15.	27 ,9 *Dec.* 15.
Differ.	2 ,05	2 ,15	2 ,15	2 ,15

1734.	*Darlington.*	*Wittemberg.*	*Noremburg.*	*Edinburgh.*
January		29 ,8	28 ,58	29 ,9
February		72	96	6
March	29 ,40	51	34	5
April	6	59	97	8
May	30 10	54	65	8
June	29 8	63	42	8
July	8	56	66	7
Auguſt	9	60	63	6
September	7	37	71	6
October	8	07	48	5
November	3	66	71	9
December	8	57	5	0
Mean of the whole Year	29 ,87	29 ,56	28 ,63	29 ,64
☿ Higheſt		30 ,35 *Jan.* 11.	29 ,2 *Jan.* 22.	30 ,6 *Jan.* 12.
Loweſt		28 ,45 *Dec.* 14	27 ,66 *Dec.* 26.	28 *Dec.* 14.
Differ.		1 ,89	1 ,53	2 ,6

The

The Thermometrical Table for the Year 1734.

1734.	*Crane-Court.*	*Southwick.*	*Darlington.*	*Wittemberg.*	*Edinburgh.*
January	67	68		81 ,2	75
February	58 ,7	57 ,5		66 3	65
March	51 7	54	60 ,6	63 9	61
April	47 6	50	51 1	53 4	54
May	45 3	47 5	46 3	40 6	55
June	36 9	39	40 2	32	43
July	34 7	35 5	35 6	33	41
August	34 6	37	37 3	34 5	46 5
September	45 6	47	45 4	49 5	55
October	56 4	56 5	55 6	71	61
November	61 1	64	60 3	88 6	72
December	63 5	65	63 ,4	76 7	74
Mean of the whole Year	49 3	52		57 ,5	58 ,5
Thermom. ☿ Higheſt	20 *Aug.* 8.	23 *Aug.* 23.		9 *June* 28.	19 ,5 *June* 19.
Loweſt	77 ,5 *Jan.* 16.	87 *Jan.* 10.		102 *Nov.* 27.	92 *Jan.* 13.
Differ.	57 ,5	64		93 ,5	72 ,5

A Table of the Depth of Rain for the Year 1734.

1734.	*Crane-Court.*	*South wick*	*Kent*	*Canterbury*	*Darlington.*	*Wittemberg*	*Rome.*	*Padua.*	*Edinburgh.*
January	1 ,01	,5	1 ,63			,86		1 ,03	,59
February	1 935	2 6	2 43			2 04		1 73	59
March	1 79	8	1 98	,74	3 ,25	2 95		1 55	2 12
April	45	6	59	75	1 7	55		1 7	1
May	4 17	5 1	3 89	1 49	2 1	3 7		4 37	3 31
June	3 21	1 3	2 13	3 59	2 4	1 67		4 55	2 21
July	1 11	1 8	1 4	1 94	1 6	2 47		7 01	7
August	1 76	4	2 16	2 34	2 4	1 09	3 59	3 08	1 28
September	1	1 7	1 59	1 54	1 35	2 01	5 83	2 89	1 17
October	2 1	2 8	3 13	3 94	2 4	2 08	15 83	4 39	1 32
November	1 77	9	1 49	1 61	2 3	73	5 15	1 3	1 01
December	4 27	4 4	7 26	6 52	1 7	75	6 02	4 9	2 33
Total	24 ,57	27 ,5	29 ,72	23 ,98	21 ,2	20 ,95		38 ,56	19 ,22

The

The Barometrical Table for the Year 1735.

1735.	*Crane-Court.*	*Southwick.*	*Coventry.*	*Darlington.*	*Norimberg.*	*Edinburgh.*
January	30 ,09	29 ,47	29 ,13	29 ,4	28 ,3	29 ,5
February	1	63	42	4	7	7
March	29 84	36	15	73	41	3
April	30 03	49	26	45	60	7
May	14	60	42	30 7	54	8
June	11	56	35	29 92	63	
July	02	50	32	65	64	
Auguſt	31	72	46	92	83	
September	23	69	52	97	86	
October	19	69	44	30 10	72	
November	00	45	26	29 65	60	
December	13	59	37	80	71	
Mean of the whole Year	30 ,09	29 ,56	29 ,34	29 ,75	28 ,63	
☿ Higheſt	31 *Jan.* 4	30,17 *Feb.* 11.	30 *Feb.* 2.		29,22 *Nov.* 24.	
Loweſt	28,6 *Jan.* 8	28,00 *Jan.* 8.	27,9 *Jan.* 8.		28,02 *Jan.* 10.	
Differ.	2,4	2,17	2,1		1,19	

The Thermometrical Table for the Year 1735.

1735.	*Crane-Court.*	*Southwick.*	*Darlington.*	*Edinburgh.*
January	65 ,2	65	62 ,8	73
February	62 8	62 ,5	66 3	74
March	55 9	60	56 2	69
April	49 7	50 5	49 3	61
May	46 5	48	45 2	54
June	39 5	41 5	39 1	
July	35 8	37 5	36 2	
Auguſt	34 6	38	34	
September	39 7	42	44 3	
October	55 9	56	56 2	
November	55 1	56 5	58	
December	61 5	62	64 2	
Mean of the whole Year	50 ,11	52	50 ,9	
Thermom. Higheſt	21 *Aug.* 13.	21 *Aug.* 13.		
Loweſt	76 *Dec.* 16.	81 *Dec.* 23.		
Difference	55	60		

A Table of the Depth of Rain for the Year 1735.

1735.	*Crane-Court.*	*Southwick.*	*Darlington.*	*Padua.*	*Rome.*
January	2 ,36	2 ,1	1 ,65	4 ,05	6 ,26
February	1 78	7	2 40	2 42	67
March	2 24	2 2	2 26	5 16	5 30
April	1 16	1 7	1 18	1 45	2 72
May	2 04	1 5	1 50	2 68	2 68
June	2 08	2 4	2 21	3 86	3 22
July	3 14	2 3	3 11	4 99	0 00
Auguſt	1 49	3 2	2 03	72	
September	1 56	3 2	1 04	1 28	
October	98	1 7	1 98	1 87	
November	2 69	1 7	2 87	54	
December	1 5	2 1	1 84	63	
Total	22 ,83	25	24 ,07	29, 68	

LVIII. Theſe Obſervations are made according to Dr *Jurin*'s Directions, and with the ſame Inſtruments, that were made uſe of in the 6 preceding Years.

A Summary of Meteorological Obſervations made for 6 *Years at* Padua, *by the Marquis* Poleni, *F. R. S.* No. 448. p. 239. June, *&c.* 1738.

TABLE A.

	1731. Dig.	1731. Dec.	1732. Dig.	1732. Dec.	1733. Dig.	1733. Dec.	1734. Dig.	1734. Dec.	1735. Dig.	1735. Dec.	1736. Dig.	1736. Dec.
January	2	546	2	129	1	855	1	034	4	052	6	541
February	3	093	1	959	0	405	1	735	2	420	2	981
March	0	976	2	765	5	642	1	558	5	162	2	721
April	3	434	5	432	3	816	1	706	1	452	1	227
May	0	602	1	864	5	330	4	372	2	681	4	444
June	4	253	2	872	2	712	4	555	3	865	2	777
July	3	402	1	585	3	874	7	015	4	992	3	064
Auguſt	7	372	3	112	3	679	3	082	0	720	1	844
September	2	216	0	089	0	589	2	899	1	287	2	479
October	4	354	9	164	2	788	4	391	1	878	0	529
November	1	653	0	957	0	382	1	307	0	542	1	454
December	0	306	3	528	1	065	4	909	0	634	0	572
Sum of the whole Year.	34	207	35	456	32	137	38	563	29	685	30	633

This

This Table repreſents the Water of 6 Years, collected from Rain and melted Snow. If you take all the Months together, you will find that the Quantity of Water, which fell in the Months of *November*, Dig. 6. Dec. 295. is the leaſt; and that what fell in the Months of *July*, Dig. 23. Dec. 932. is the greateſt: Whereas in the preceding 6 Years the ſmalleſt Quantity fell in the Months of *Feb.* and the greateſt in *Oct.* The Difference between the leaſt and greateſt Quantity before was Dig. 22. Dec. 796; but now it is Dig. 17. Dec. 637.

It appears alſo from the ſame Table, that the Year 1735 was the moſt dry, being Dig. 29. Dec. 685; and that 1734 was the moiſteſt, being Dig. 38. Dec. 563. In the preceding 6 Years the Difference between the moſt dry and the moſt wet was Dig. 27. Dec. 505; but in theſe Dig. 8. Dec. 878.

TABLE B.

	Winter.		Spring.		Summer.		Autumn.	
	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.
1731.	5	759	6	647	13	598	8	17
1732.	4	522	10	300	7	226	10	186
1733.	6	321	15	758	8	762	3	759
1734	4	74	8	14	14	34	10	125
1735.	10	450	10	848	7	805	3	337
1736.	11	945	8	54	6	371	4	588
Sum.	43	71	59	621	57	796	40	12

In this Table it appears, that the Quantity of Water collected in Summer and Autumn, in 3 Years, was greater than the Quantity collected in Winter and Spring; and that in the other 3 Years it was leſs: Whereas in the former Space of 6 Years the Quantity collected in Summer and Autumn was always the greateſt. In thoſe 6 Years the Seaſons, according to the Increaſes of the Sums of Water collected, were to be placed in the following Order; Winter, Spring, Summer, Autumn: But in the laſt 6 Years they muſt be placed thus; Autumn, Winter, Summer, Spring.

In this Space of 6 Years, the Sum of the Quantity of Water collected in Summer and Spring exceeds the Sum of Water collected in Winter and Autumn. And in both Spaces the Summer is one of the Seaſons of greater Quantity, and the Winter of leſs.

TABLE C.

The Barometer decreasing from the Noon of the preceding Day to the Noon of the Day on which it rained.		The Barometer increasing from the Noon of the preceding Day to the Noon of the Day on which it rained.	
Number of the Days on which it rained.	Wind at Noon on the Days in which it rained.	Number of the Days on which it rained.	Wind at Noon on the Days in which it rained.
140	N	80	N
47	NE	29	NE
15	E	7	E
18	SE	4	SE
27	S	14	S
28	SW	17	SW
33	W	24	W
62	NW	31	NW
Sum 370		Sum 206	

As I wondered in the corresponding Table of the former 6 Years, so in this Table also I have observed, not without Wonder, that there was no greater Difference between the Numbers of the Increase and Decrease of the Height of the Barometer (on the rainy Days) than between 370 and 206: Which is almost the same as that of the former Tables; namely, 378 and 211.

It is worthy also of Observation, that in the whole former Space of 6 Years the rainy Days were 589; and in the latter 576: A small Difference only of 13 Days between both Spaces. In both a greater Quantity of Rain was brought by the N. than by any other Wind; and the least by the E. and S E.

TABLE D.

The Barometer decreasing from the Noon of the preceding Day to the Noon of the Day on which it snowed.		The Barometer increasing from the Noon of the preceding Day to the Noon of the Day on which it snowed.	
Number of the Days on which it snowed.	Wind at Noon on the Days in which it snowed.	Number of the Days on which it snowed.	Wind at Noon on the Days in which it snowed.
3	N	5	N
1	NE	2	NE
1	W	1	SW
1	NW	1	W
Sum 6		Sum 9	

In the first 6 Years it snowed more when the Barometer decreased, than when it increased; but it is the contrary in this Table. In those 6 Years there were 18 snowy Days, and in these there were 15.

TABLE E.

	Sum of the Heights of the Barometer.		Sum of the Heights of the Thermometer.		Mean Height of the Barometer on each Day.		Mean Height of the Thermometer on each Day.	
	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.
1731.	10850	65	18286	25	29	72	50	9
1732.	10870	19	18361	30	29	70	50	17
1733.	10867	18	18301	95	29	77	50	14
1734.	10850	24	18305	78	29	73	50	15
1735.	10861	21	18274	87	29	76	50	6
1736.	10870	7	18338	42	29	70	50	10

The mean Height of the Barometer in this whole Space of 6 Years is Dig. 20. Dec. 73. differing only 3 decimal Parts from that of the former 6 Years, which was Dig. 29. Dec. 70.

The mean Height of the Thermometer for each Day in this Space is Dig. 50. Dec. 12. differing only 4 decimal Parts from that of the former 6 Years, which was Dig. 50. Dec. 16.

The daily mean Heights both of the Barometer and Thermometer, belonging to each Year, hardly differ in this Table; as they agreed also very well together in the Table of the former 6 Years.

TABLE F.

Years.	Months.	Days O. S.	Hours. h	′	Greatest Height of the Barom. Dig.	Dec.	Least Height of the Barom. Dig.	Dec.	Height of the Thermometer. Dig.	Dec.	Winds.	Weather.
1731.	*Feb.*	6		15	30	26			48	36	NW	Fair.
	Jan.	29		15			28	70	47	92	SE	Foggy.
1732.	*Dec.*	10		15	30	20			48	32	N	Fair.
	Mar.	11	2				28	85	49	67	SW	Cloudy.
1733.	*Jan.*	23		15	30	48			48	62	NW	Fair.
	Mar.	19		15			28	96	49	18	N	Rain.
1734.	*Jan.*	12		15	30	34			48		N	Fair.
	Dec.	15		15			28	88	48	30	S	Cloudy. [Part.
1735.	*Feb.*	8		15	30	30			48	40	NW	Cloudy for the most
	Mar.	17		15			29		49	48	W	Small Rain.
1736.	*Nov.*	19		15	30	20			48	70	N	Fair
	Feb.	12		15			28	88	48	74	NW	Cloudy.

TABLE

TABLE G.

Years.	Months.	Days O. S.	Hours. h	′	Height of the Barometer. Dig.	Dec.	Greateſt Height of the Therm. Dig.	Dec.	Leaſt Height of the Therm. Dig.	Dec.	Winds.	Weather.
1731.	*June*	29		15	29	80	52	40			SE	Fair.
	Jan.	27		15	29	30			47	44	NW	Small Rain. [ternately
1732.	*July*	20	4		29	62	52	52			NW	Sun-ſhine and cloudy al-
	Dec.	6		15	29	55			47	75	W	Fair.
1733.	*June*	29		15	29	86	52	38			NW	Fair. [Part.
	Dec.	13		15	30	10			47	85	W	Cloudy for the moſt
1734.	*July*	1		15	29	70	52	24			NE	Sun-ſhine & cloudy alt.
	Jan.	14		15	30	12			47	92	SW	Fair.
1735.	*Aug.*	26		15	29	78	52	18			W	Fair.
	Dec.	27		15	30	14			47	74	W	Sun-ſhine & foggy.
1736.	*July*	22		15	29	90	52	30			NE	Fair.
	Dec.	20		15	29	78			47	92	W	Cloudy.

By comparing theſe Tables with the correſponding ones in my former, it appears that the greateſt Height of the Barometer, Dig. 30. Dec. 48. exceeded the greateſt in the former 6 Years, which was Dig. 30. Dec. 40. But the Depreſſion of the Quickſilver Dig. 28. Dec. 70. yields to that of the former 6 Years, which was Dig. 28. Dec. 56.

The greateſt Height of the Thermometer in theſe new Tables is Dig. 52. Dec. 52; in the former Dig. 52. Dec. 54; only two decimal Parts more. The leaſt Height in theſe Tables is Dig. 47. Dec. 44; in the former Dig. 47. Dec. 58. Therefore in the laſt 6 Years the Quickſilver ſunk 14 decimal Parts lower than in the former.

TABLE H.

Years N. S.	*Paris* Inches.	Lines.
1731.	31	11 $\frac{3}{5}$
1732.	30	$\frac{1}{5}$
1733.	32	5 $\frac{2}{5}$
1734.	35	5 $\frac{1}{2}$
1735.	28	7 $\frac{4}{5}$
1736.	29	2 $\frac{4}{5}$
	Sum 187	9 $\frac{1}{3}$

This Sum of 187 Inches, 9 $\frac{1}{3}$ Lines, being divided into 6 equal Parts, gives the mean Meaſure of the Water for each Year 31 Inches, 3 $\frac{7}{12}$ Lines. In the former 6 Years it was found to be 35 Inches $\frac{7}{12}$ Lines: Therefore the Difference is 3 Inches 9 Lines.

Now if we add the Sums of theſe 2 Spaces of 6 Years into one, and divide it by 12, we ſhall find the mean Quantity for each Year to be

33 Inches 2 $\frac{1}{7}$ Lines. And if we compare this Quantity with the mean Measure of Water, which falls at *Paris* 19 Inches, or 18 Inches 8 Lines, it will appear, that there falls a much greater Quantity of Water at *Padua*, than at *Paris*.

These 6 Years furnish also an Observation, that there sometimes falls at *Padua* in 24 Hours, a much greater Quantity of Water, than ever falls within the same Space of Time at *Paris*. From the Noon of *Oct.* 27, 1732, *O. S.* Wind N. to the Noon of the following Day, there fell 2 Inches of Rain and about 9 Lines, which is much more than ever was observed to fall at *Paris*.

The greatest Height of the Barometer, *Jan.* 23, 1733, observed in these 6 Years, being reduced to *French* Measure, is 28 Inches 6 $\frac{9}{10}$ Lines. The least Height *Jan.* 29, 1731, is 26 Inches 10 $\frac{7}{10}$ Lines. The Difference between the greatest and least Height is 1 Inch 8 Lines. And as the greatest Difference at *Paris* was 1 Inch 11 $\frac{1}{6}$ Line, it exceeds that at *Padua* 3 $\frac{1}{6}$ Lines. Thus the Differences in my former Account are confirmed by these new Observations.

I have found, by repeated Observations, the Declination of the magnetical Needle in *Apr.* 1733 to be 13 $\frac{1}{2}$ Deg. to the W. At the latter End of 1736 I found it to be 13 $\frac{45}{60}$ Deg. Therefore, by comparing this with my former Account, it will appear, that the Declination was greater in the 3 first of these 6 Years, than in the 3 last.

Padua, June 1, 1737.

Remarks on the Weather, with 3 Synoptical Tables of meteorological Observations for 14 Years, viz. from 1726 to 1739, both inclusive, by Geo. Lynn, *Esq;* No. 460. *p.* 686. April, *&c.* 1741.

LIX. Having, for these 14 Years last past, kept a constant Register or Diary of the Altitudes of the Barometer and Thermometer, the Quantity of Rain, Course of the Winds, *&c.* according to Dr *Jurin*'s Invitation, the five first Years of which have been communicated to the *R. S.* I now send the remaining 9 Years at large, ending *Dec.* 1739, in the same Method as formerly. But, believing it would be of good Use, both here and abroad, if the mean Heights of the Barometer, Thermometer, and Quantity of Rain in every Month of the whole 14 Years, with the collateral Means, both of the Months and Years, were brought all into one View together, I have taken the Pains to range them accordingly in a Scheme, or Table. The Meaning of the several Columns in that Scheme is, in a great Measure, explained by the Titles of them; and by the lowest Line you will find, that the mean Height of the Barometer for the whole 14 Years is 29.58 Inches; the mean Quantity of Rain annually, 23 Inches; and the mean Altitude of the Thermometer $\left|\begin{smallmatrix}56|48\\52\end{smallmatrix}\right|$ that is, at the coldest Time of the Day 56, at the hottest 48, and their Mean 52. In the middle Column, *viz.* that of Rain, the *Commas*, *Semicolons*, and *Colons*, over the Figures, denote, by their Manner of placing, from the Left to the Right, what Time in the Month the Rain fell, whether at the Beginning, Middle, or latter End; the *Comma* [,] denotes a small Quantity, the *Semicolon* [;] a middling Quantity, and the *Colon* [:] a large Quantity; shewing the different

ferent Proportion that fell at thoſe Parts of the Months. The Thermometer made uſe of all along, is that of Mr *Haukſbee*, and kept conſtantly in the ſame Place, as mentioned by Mr *Geo. Hadley* *. And the Altitudes of the Thermometer are taken but twice a Day, *viz.* at the coldeſt, which is at Sun-riſe, or ſometimes a little after; and at the hotteſt, *viz.* between 2 and 4 in the Afternoon: By which Method are gained the proportional Heats for every Month in the Year, and their Difference, as alſo between that of Day and Night, for 13 Years together; not reckoning in the Year 1726, which may be ſeen by the Scheme to be in another Method, and not filled up.

Great Care has been taken, in caſting up and dividing, to get the exact Mediums and Sums; and I was not a little ſurpriſed to find, in caſting up the Column of the mean Altitudes of the Thermometer collaterally, that as thoſe for *July*, being the hotteſt Month, are $\left|\begin{smallmatrix}41\\35\frac{1}{2}\end{smallmatrix}\right|\begin{smallmatrix}30\\\frac{1}{2}\end{smallmatrix}$ ſo the Altitudes of *June* and *Aug.* on each Side of it, come out exactly equal to one another, and alſo thoſe of *May* and *Sept.* theſe laſt only differing in their Morning and Evening Heats or Altitudes, which does not alter their Medium of $44\frac{1}{2}$.

When there is a Hazineſs in the Air, ſo that the Sun's Light quails by Degrees, and his Limb is ill defined, it is a pretty certain Sign of Rain, eſpecially if the *Mercury* falls. The like Hazineſs at Night is ſtill more a Sign of it.

It is obſervable, that though the *Mercury*, in the Summer Months, does not ſo much vary in it's Altitude as at other Times of the Year, yet in that Seaſon we have the moſt Rain: It ſhould ſeem therefore, that the different Warmths (and conſequently Rarefaction of Vapours) in the upper and lower Currents of the Air, and thoſe Currents mixing, and ſometimes wholly interchanging, are then the more immediate Cauſes of the Rains, if not alſo of Thunder and Lightning.

Black fleecy Clouds, formed upon a ſudden Flurry of the Wind, are generally ſucceeded by a Shower; and the ſhifting of the Wind in a little Time almoſt round the Compaſs, in hot Weather, is often ſucceeded by a Thunder-ſhower.

Several Times, when the *Mercury* has been a good while high, and ſo continues, there has fallen miſtling Rain, eſpecially about the New and Full Moon, with an Eaſterly Breeze, which the Borderers on the Coaſt of *Lincolnſhire* and *Norfolk* call *Tide-Weather*, and may be occaſioned by the Vapours ariſing from the Tides, which then cover a vaſt Waſh of Sands in their Neighbourhood.

Thoſe Vapours ſometimes reach us here in *Northamptonſhire*, but I believe ſeldom further W.

The Nights are for the moſt Part calmer than the Days; and the Winds ſeldom ſettled in their Quarter, or at their Strength, till ſome Hours after Sun-riſe, and generally die away again before Sun-ſet.

Southwick, April 21, 1740.

N. Lat. 52°—31′.

* See § LVII.

Synoptical

Synoptical Tables of the Meteorological Obſervations made by George Lynn, *Eſq; at* Southwick, *near* Oundel *in* Northamptonſhire, *for the Years from* 1726 *to* 1739 *incluſively.*

	The Barometer's mean Altitude (above 29 Inches) in 100 Parts of an Inch, In the Years						
	1726	1727	1728	1729	1730	1731	1732
January		.36	.28	.70	.79	.61	.54
February		.51	.86	.66	.39	.57	.65
March		.66	.48	.54	.34	.92	.57
April	.75	.72	.48	.60	.66	.51	.52
May	.74	.49	.64	.57	.55	.72	.50
June	.63	.58	.68	.69	.60	.66	.71
July	.68	.65	.64	.64	.61	.72	.65
Auguſt	.45	.77	.64	.72	.70	.65	.70
September	.44	.50	.59	.42	.34	.70	.63
October	.77	.44	.38	.52	.49	.67	.68
November	.74	.84	.53	.32	.55	.54	.75
December	.50	.33	.51	.52	.83	.61	.47
The mean Altitudes in the ſeveral Years.		.57	.56	.57½	.57	.66	.61

The

	The Barometer's mean Altitude (above 29 Inches) in 100 Parts of an Inch, In the Years							The mean Altitudes collaterally.
	1733	1734	1735	1736	1737	1738	1739	
January	.68	.80	.47	.26	.86	.70	.45	.58
February	.55	.60	.63	.22	.58	.61	.60	.55
March	.43	.52	.36	.44	.45	.46	.48	.51
April	.65	.69	.49	.70	.67	.53	.34	.52
May	.70	.54	.60	.58	.70	.52	.60	.60
June	.67	.65	.56	.76	.73	.50	.56	.64
July	.67	.63	.50	.67	.59	.72	.67	.65
Auguſt	.56	.57	.72	.63	.55	.60	.61	.63
September	.62	.56	.69	.71	.46	.65	.49	.56
October	.72	47	.69	.33	.60	.52	.71	.57
November	.75	.74	.45	.64	.68	.67	.32	.61
December	.53	.22	.59	.53	.70	.58	.65	.54
The mean Altitudes in the ſeveral Years.	.63	.58	.56	.54	.63	.59	.54	.58

The

The Quantity of Rain in Inches and Decimals for every Month, In the Years

	1726	1727	1728	1729	1730	1731	1732
January	4.2	3.1	4.0	0.2	0.4	0.8	3.9
February	1.0	2.6	0.9	0.5	1.5	1.0	1.2
March	1.5	1.4	3.3	1.3	2.6	0.1 ½	1.4
April	1.0	1.2	2.0	1.1	0.8	2.1	1.2
May	0.4	4.3	1.4	1.6	2.5	0.3	3.4
June	4.0	3.2	2.8	0.8	3.4	3.4	0.6
July	3.7	2.0	3.2	2.3	2.0	1.7	1.8
Auguſt	0.3	0.3	1.0	2.4	0.8 ½	1.6	1.7
September	5.2	2.0	0.8 ½	5.3	1.6	1.5	0.7
October	1.5	1.5	2.8	2.2	3.0	1.4	3.7
November	1.4	0.4	1.5	4.2	2.0	1.5	1.2
December	2.5	2.8	2.4	1.7	0.8	2.3	2.6
The mean Quantity of Rain in the ſeveral Years.	26. ½	25.	26.	23. ½	21.	17. ½	20. ½

The

	The Quantity of Rain in Inches and Decimals for every Month, In the Years							The mean Quantity collaterally.
	1733	1734	1735	1736	1737	1738	1739	
January	1.0	0.5	2.1	2.3	1.0	1.7	2.4	1.8
February	1.4	2.6	0.7	2.9	2.2	0.8	3.1	1.6
March	2.2	1.8	2.2	2.1	2.1	1.0	1.3	1.7
April	1.0	0.6	1.7	0.6	0.4	1.3	2.2	1.2
May	0.02	5.1	1.5	0.8	1.7	1.9	1.9	1.9
June	2.0	1.3	2.4	1.4	1.8	3.4	1.5	2.3
July	2.2	1.8	2.3	6.0	0.7	1.2	1.7	2.3
Auguſt	3.6	4.0	3.2	1.7	5.7	1.6	2.5	2.2
September	1.4	1.7	3.2	1.4	3.8	1.8	1.8	2.3
October	0.6	2.8	1.7	2.6	1.8	1.8	0.8	2.0
November	0.5	0.9	1.7	0.6	0.6	0.7	1.7	1.4
December	1.7	4.4	2.1	2.0	2.3	1.2	1.9	2.2
The mean Quantity of Rain in the ſeveral Years.	17. ½	27. ½	25.	24.	24.	18.	22. ½	23.

The Thermometer's mean Altitudes taken (from *April* 13th, 1727) at the coldeſt and hotteſt Time of the Day, and their Mean, In the Years

	1726	1727	1728	1729	1730
January		at 10 | at 3 65 |	68 | 65 66 1/8	70 | 66 68	69 | 64 66 1/2
February		at 10 | at 3 59 | 57 58	69 | 62 65 1/2	74 | 67 70 1/2	68 | 61 64 1/2
March		at 10 | at 3 62 | 58 60	59 | 53 56	69 | 60 64 1/2	62 | 54 58
April	at 10 | at 3 40 | 33 36 1/2	52 | 45 48 1/2	57 | 47 52	61 | 50 55 1/2	58 | 46 52
May	at 10 | at 3 25 | 20 22 1/2	45 | 39 42	47 | 35 41	53 | 42 47 1/2	49 | 38 43 1/2
June	at 10 | at 3 36 | 31 33 1/2	42 | 32 37	41 | 30 35 1/2	43 | 30 36 1/2	46 | 35 40 1/2
July	at 10 | at 3 37 | 31 34	37 | 26 31 1/2	41 | 31 36	42 | 30 36	42 | 32 37
Auguſt	at 10 | at 3 40 | 31 35 1/2	43 | 27 35	43 | 34 38 1/2	43 | 31 37	44 | 32 38
September	at 10 | at 3 43 |	49 | 38 43 1/2	53 | 43 48	46 | 37 41 1/2	47 | 39 43
October	at 10 | at 3 52 |	57 | 51 54	58 | 52 55	57 | 50 53 1/2	55 | 43 49
November	at 10 | at 3 62 |	66 | 60 63	67 | 61 64	60 | 57 59 1/2	59 | 52 55 1/2
December	at 10 | at 3 70 |	71 | 68 69 1/2	72 | 70 71	63 | 60 61 1/2	70 | 65 67 1/2
The mean Altitudes of the Thermometer in the ſeveral Years.		54 | 46 50	56 | 49 52 1/2	57 | 48 52 1/2	56 | 47 51 1/2

The

The Thermometer's mean Altitude taken at the coldeſt and hotteſt Time of the Day only, and their Mean, In the Years

	1731	1732	1733	1734	1735
January	75|69 72	70|65 67 ½	65|58 61 ½	71|65 68	68|42 65
February	70|63 66 ½	61|53 57	64|56 60	61|54 57 ½	66|59 62 ½
March	63|52 57 ½	64|53 58 ½	64|55 59 ½	59|49 54	64|56 60
April	62|52 57	56|48 52	57|46 51 ½	56|44 50	55|46 50 ½
May	50|34 42	53|44 48 ½	54|40 47	53|42 47 ½	53|43 48
June	45|31 38	46|34 40	43|29 36	44|34 39	46|37 41 ½
July	43|29 36	42|31 36 ½	38|27 32 ½	40|31 35 ½	42|33 37 ½
Auguſt	42|32 37	47|33 40	45|34 39 ½	42|32 37	43|33 38
September	48|36 42	49|39 44	52|44 48	51|43 47	46|38 42
October	52|46 49	55|47 51	60|52 56	60|53 56 ½	60|52 56
November	62|57 59 ½	67|62 64 ½	61|55 58	66|62 64	59|54 56 ½
December	66|61 63 ½	68|64 66	58|53 55 ½	67|63 65	64|60 62
The mean Altitudes of the Thermometer in the ſeveral Years.	56|47 52	57|48 52	55|46 50	56|48 52	56|48 52

The Thermometer's mean Altitude taken at the coldeſt and hotteſt Time of the Day only, and their Mean,

In the Years

	1736	1737	1738	1739	The mean Altitudes collaterally.
January	64|60 62	63|59 61	63|57 60	63|58 60 ½	67|62 64 ½
February	71|67 69	65|59 62	66|61 63 ½	60|53 56 ½	66|59 62 ½
March	63|54 58 ½	65|58 61	62|54 58	65|57 61	63|55 59
April	57|46 51 ½	56|47 51 ½	58|49 53 ½	60|52 56	57|48 52 ½
May	54|44 49	49|35 42	48|36 42	49|37 43	50|39 44 ½
June	42|30 36	47|35 41	46|37 41 ½	44|33 31 ½	44|33 38 ½
July	41|31 36	41|29 35	42|30 36	41|32 37	41|30 35 ½
Auguſt	42|32 37	47|39 43	45|37 41	46|36 41	44|33 38 ½
September	49|38 43 ½	47|40 43 ½	51|43 47	48|41 44 ½	49|40 44 ½
October	53|47 50	60|55 57 ½	57|50 53 ½	60|53 56 ½	57|50 53 ½
November	62|57 59 ½	62|56 59	63|57 60	68|63 65 ½	63|58 60 ½
December	63|60 61 ½	67|65 66	65|62 63 ½	70|66 68	66|63 64 ½
The mean Altitudes of the Thermometer in the ſeveral Years,	55|47 51	56|48 52	55|48 51 ½	56|48 52	56|48 52

Extracts from the Roman *Meteorological Diaries for* 1741, *by the Abbot* Didacus de Revillas, *Prof. Math. Acad.* Rom. *F. R. S.* No. 466. *p.* 193. *Read* Nov. 18, 1742.

LX. We made uſe of a very exact Barometer, divided both by a *Paris* and *London* Scale into Inches and duodecimal Parts of an Inch, with a ſliding Index. The Room, in which it is placed, is a little above the Middle of the Capitoline Cliff: Hence it is in a mean Region between the upper and lower Parts of the City.

Our mercurial Thermometer is like that of *Fahrenheyt*, but it's Baſon is neither ſpherical nor cylindrical, nor of any other Figure commonly uſed in Thermoſcopes; but has a hemiſpherical Concave, that the whole Maſs of Quickſilver, contained between the two hemiſpherical Sides of the Glaſs, may the more readily follow the Variations of the Atmoſphere; and that the Aſcent and Deſcent of the Quickſilver may by no Means be vitiated by the Variations of the Glaſs, which ariſe from a more intenſe Heat or Cold. The whole Capacity of the Inſtrument is divided into 5000 Parts, into as many of which the Scale is divided, as the Tube can contain, beginning at the Top. The Quickſilver riſes to the Beginning of the Scale, and Top of the Tube, with the Heat of boiling Water. The Cold of Water beginning to freeze, ſinks it to 178°, and actual Froſt to 180°. But if the Cold is more intenſe, and the Quickſilver falls below this Degree, the Increaſe of Cold is marked by a greater Number of Degrees. This Thermometer is placed on the Outſide of a Window, oppoſite to the E N E, and Steps of the Capitol; ſo that it never receives the direct Rays of the Sun; and is therefore fit to ſhew the Degrees of Heat and Cold accurately.

We collected the Rain after Dr *Halley*'s Method, in a cylindrical Veſſel, nine Inches deep, *London* Meaſure, and 2 Feet 4 Inches in Diameter. Out of this Veſſel the Water is received through a Spout into another cylindrical Veſſel, one Foot both in Depth and Diameter, covered with a Lid, to keep the Water from evaporating. When the Rain ceaſes, it is taken out, and meaſured in another cylindrical Veſſel, exactly meaſuring one Foot, and exactly equal in Diameter to $\frac{1}{10}$ of the Diameter of the greater Veſſel, which immediately receives the falling Rain. Therefore, ſince the Diameters of theſe Veſſels are as 10 to 1; their Baſis will be as 100 to 1.

Therefore becauſe of the reciprocal Altitude of equal Cylinders with the Baſis, one Inch Depth of Water in the greater Veſſel will be equal to 100 Inches in the ſmaller. That is, the Inches of Water which this ſmaller Cylinder meaſures, ſhow as many $\frac{1}{100}$ Parts of an Inch Depth of Rain. But in the ſmall Veſſel, the Rule uſed to meaſure is purpoſely divided into Inches and Tenths, ſo that each Diviſion thereon ſhews $\frac{1}{1000}$ Part of an Inch Depth of Rain.

We generally made 4 Obſervations every Day; and ſometimes more; in the Morning early, at Noon, after Sun-ſet; and about 2 Hours before Midnight; and in Summer at 2 or 3^h *p. m.*

The thermometrical Obſervations relating to Cold in Winter are to be underſtood of the Morning, unleſs it is otherwiſe mentioned: For

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at that Time the Air is naturally coldeſt. In Summer they are to be underſtood of Noon or Afternoon, when the Heat is ſtrongeſt.

1741 January. Though there fell almoſt as great a Quantity of Rain in the laſt 2 Months of the preceding Year, as in the other 10, yet *Jan.* was very rainy: For the ſame Winds, which ruled on the Days next the preceding Solſtice, and generally bring Rain at *Rome*, prevailed alſo at the Beginning of this Month: Namely, the E. and S. and the intermediate Winds. Hence proceeded Rain, and the Sky was for the moſt Part cloudy. It was Full-Moon after Midnight of the firſt Day of the Month. The Barometer at this Time fluctuated between 8 and 10 Lines above 29 Inches. The Thermoſcope indicated a great Cold, falling to 158°, which was much leſs than that in the Beginning of *November*, when it froze in the Streets, the Thermoſcope being then at 178°.

On the 8th the Northern Winds began to prevail, eſpecially the N N E, the Sky was cleared from Clouds, and a pleaſing Serenity ſucceeded; which continued, with very little Interruption, till the 17th, being hardly ever diſturbed by Morning Fogs, or ſcattered Clouds. But the Barometer, which on the 10th had riſen to 29 Inches 10 ½ Lines, fell continually, and on the 17th was fallen to 29.4, the Wind E N E. In the Night of the 16th and 17th, the Wind being at N E, it froze: The Thermometer marking 180°. And this was the greateſt Cold of the whole Year. The laſt Quarter of the Moon was on the 9th after Midnight, and the New-Moon on the 17th Afternoon.

On the 19th the S. and E. and S E prevailing again, the Barometer fell to 29.1 with an E. Wind. This was the leaſt Height of the Quickſilver in the whole Year, though on the 25th it fell to 29.1 ¼. Very frequent Showers till the 28th: But eſpecially on the 25th and 26th there were remarkable Depreſſions of the Barometer. On the 25th we collected 2 Inches of Water, and on the 26th, 1 ⅓ Inch. On theſe Days the Thermoſcope hardly ever departed from 156 and 160° early in the Morning. The firſt Quarter of the Moon was on the 23d after Midnight.

Beſides the Showers, which fell on the 25th and 26th, the Snows of the Mountains being melted by the S. Winds, brought a great Quantity of Water into the *Tiber*; which overflowing it's Banks on the 27th, not only drowned the adjacent Fields to the City, but alſo the lower Parts of the City itſelf. The Baſis of the Columns in the Portico of the Pantheon were covered with Water. It roſe 9 Inches higher than the other Flood of the 7th of laſt Month.

At the latter End of *Jan.* the Winds were Northerly again, eſpecially N N E, and brought fair Weather. The Coldneſs of the Air was ſhewn by the Thermoſcope being at 169° in the Morning. Full-Moon on the 31ſt after Sun-ſet.

The greateſt Cold of this Month was marked by the Thermometer being at 180°.

The greateſt Height of the Barometer was —	Inches	30.1
Leaſt — — — — — — — — —		29.1
Depth of Rain — — — — — —		6.847

The fair Weather hardly laſted to the 2d Day of the Month: On the 3d the Sky was covered with Clouds, and a little Rain fell; the Clouds continued frequent till the 8th, the Barometer hardly ever fell from the Height of 29.10; gentle Winds at S. and E. February.

On the 8th the laſt Quarter of the Moon before Midnight; Wind E N E, then N E, Barometer 29.11 ½: And the clear Weather continuing, it aroſe on the 14th to the greateſt Height of this Year, 30.5. But neither the clear Nights nor Northerly Winds, continuing till the 24th, could bring a Froſt, except on the Night preceding the 20th, when there was a hoar Froſt on the Graſs: The Thermometer being at 177 ½. On the 15th Wind N E, New-Moon: On the 22d, Afternoon, firſt Quarter; Wind N N E.

Till the 19th the Barometer kept at the Height of 3 or 4 Lines above 30 Inches: Then deſcending gradually, it came to 29.9 ½ on the 25th. Then the Sky was cloudy; and on the 26th and 27th, a little Rain fell, the S. and E. blowing alternately. The Winds and Weather were various till the End of the Month, the Barometer ſcarce falling from the Height of 29.10. The Cold was moderate on theſe Days in the Morning: The Thermometer ſtanding between 165 and 169°.

Therefore the greateſt Cold of this Month was -	Degrees	177 ½
Height of the Barometer —	Inches	30.5.
Leaſt — — — — — — —		29.7 ¾
Quantity of Rain — — — — —		0.200

This Month began with rough S. Winds and Clouds. Full-Moon on the 2d, Afternoon. Then E. and S E Winds being mixed with the S. Winds, brought frequent Showers and Clouds till the 9th. The Barometer falling daily from the Beginning of the Month, fell on the 3d to 29.3 ¼, and though it roſe again that Day to 29.6, and continued riſing, yet a ſmall Shower fell in the Evening, But on the 6th, after a new falling of the Barometer, there fell above an Inch of Rain, with a S S E Wind; and a ſmaller Shower, with an E. Wind on the 9th. March.

On the 10th was the laſt Quarter of the Moon, Afternoon; the Barometer roſe; Wind N N E, fair Weather, which continued till the 26th, with ſtrong N E Winds, ſometimes Weſterly at Sun-ſet: It blew hardeſt on the 13th. The ſame N. and W. Winds intermixt, accompanied not only the New-Moon on the 17th, and the firſt Quarter on the 23d, but alſo the Days neareſt to the Equinox. The Winds were moderate before the Equinox, but they grew ſtronger afterwards, and brought on a cold Air from the 24th to the 27th, eſpecially on the 26th, when it froze at Night, and deſtroyed all the early Bloſſoms.

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The Thermometer was that Night 179°, and on the others 175°. The Barometer, which on the Morning of the 22d roſe to 30.1 ¼, fell gradually, till on the 26th it was at 29.8 ¼.

The next Day Wind S S E, Clouds and Rain, which continued to the End of the Month; Wind frequently. The Barometer varied between 29.6 and 29 9. The Thermometer, early in the Morning, was from 165 to 168°.

The greateſt Cold this Month was — —	Degrees 179
Height of the Barometer — —	Inches 30.2
Leaſt — — — — — — — — —	29.2 ½
Quantity of Rain — — — — — —	2.034

April. The firſt Half of this Month had only the firſt and ſecond Days quite fair. Full-Moon the 1ſt. The Wind ſeldom blew from the N. unleſs at Sun-riſing: It was generally S. and E. Many ſmall Showers: Frequent Clouds. The Morning of the 9th was miſty, dark, and then rainy: The preceding Night was the laſt Quarter of the Moon. The Barometer was generally about 29.6. On the 10th it fell to 29.2, and did not continue riſing till the 13th. The Air was generally moderate: But on the 7th and 8th there was a cold N N W Wind, the Thermometer falling to 165°.

On the 15th, New-Moon Afternoon; the Barometer roſe almoſt to 30.1 Inches. The Northern Winds now began to prevail, and brought a ſharp Air from the 16th to the 20th. The Thermometer continued between 161 and 163°. The Fairneſs of the Weather and riſing of the Barometer continued till the 22d, when the Moon was in the firſt Quarter, after Sun-ſet: And the Barometer having riſen to 30.1 ¾ Inches, fell that Day and the next, the Wind being E S E. The Sky was cloudy.

On the 24th, 15 ¼h, the Thermometer being at 158°, and the Barometer at 30.0 ½ Inches, the Sky being quite clear, with a gentle E N E Wind, a ſhort Earthquake was perceived by many; in *Tuſcany* and the neighbouring Provinces it was ſtronger, and cauſed great Damage, eſpecially in the *Morea*.

The reſt of the Month was very various, the Winds being ſometimes S. ſometimes E. the Sky ſometimes clear, ſometimes cloudy, but without Rain. The Barometer ſunk gradually, and on the 30th, when it was Full-Moon before Midnight, it had fallen to 29.5 ¾; Wind S S E, a little cloudy.

Greateſt Cold — — — — — —	Degrees 165
Height of the Barometer — — —	Inches 30.1 ⅔
Leaſt — — — — — — — — —	29.3
Quantity of Rain — — — — — —	2.035

May. A ſtrong S. Wind made the firſt Day dark, though the Barometer roſe a little: In the Evening the Wind changed to the W. and then to the

the N. a Shower fell with Hail. Barometer 29.6 ½, Thermometer 164°. The Air was very cold, eſpecially on the 4th and 6th: But on the 5th, the Wind being at N E, and the Sky clear, the Vines about the City were frozen. At the Beginning of the Month it was ſeldom fair; frequent ſmall Showers, and very frequent Clouds. On the 5th the Barometer kept at 30 Inches, and fell gradually till the 11th to 29.5 ¼. On the 10th, 2 Days after the laſt Quarter of the Moon, there fell a very copious Shower.

From the 11th to the 14th, when it was New-Moon at Midnight, the Wind changing from N W to W. the Barometer roſe again to 29.11, the Sky being almoſt continually clear. Then the Winds were variable, but the W. prevailed, and the Barometer fell again: On the 16th a ſmall Shower, after which it grew clear, and the Barometer roſe again; but fell on the 20th, when there was a Shower again, with a S. Wind.

The reſt of the Month, the Winds being W. and ſometimes S. made both the Face of the Sky and Temperature of the Air various; and the ſame Winds accompanied the firſt Quarter of the Moon on the 22d, and Full-Moon on the 30th. The Barometer, though ſubject to continual Variations, did not much recede from 29 Inches 9 Lines; except on the 17th, when it reached almoſt 30 Inches. It remained in this Elevation till the laſt Day of the Month. On the two laſt Days the Sky was ſerene, but foggy.

Except the firſt 5 Days of the Month, the Thermometer continued between 153 and 163° at Sun-riſing. But though it generally reached to 150° about Noon, yet on the 16, 19, 11, 13, and 19, the Heat increaſing, and S. Wind blowing, it was at 142°.

Greateſt Height of the Barometer this Month —	Inches 30
Leaſt — — — — — — — — — — —	29.4 ¼
Quantity of Rain — — — — — — — —	2.299

The Sky was generally ſerene, and the Winds W. on the firſt four Days of the Month. The Barometer, which on the firſt Day was at 29.10 ½, gradually fell with ſome Variations; and on the 4th, after a gentle S E Wind in the Morning, it changed to E N E, and the Sky was diſturbed by a ſhort Storm and Shower. The S E generally blew on the following Days; and though the Barometer hardly ſunk, there was a new and more copious Rain, with Thunder, and a W. Wind, about 6 in the Evening, it being the laſt Quarter of the Moon. The Sky was rainy the next 3 Days, the E. Winds prevailed, and the Barometer varied between 8 and 9 Lines above 29 Inches. It fell a little on the 11th, there was a ſhort Shower, Wind S S E. June.

Then ſucceeded a Serenity, ſeldom interrupted by Clouds, with E. and W. Winds alternately, but chiefly the latter, to the End of the Month. But at Noon there was often a gentle Gale from the S. which at Sun-ſetting often gave Place to the W.

The Barometer roſe on the 12th to 29.11, and continued there all the Month; but ſometimes it roſe to above 30 Inches.

The New-Moon was on the 13th, before Noon, and the firſt Quarter on the 21ſt, after Midnight, the Sky being ſerene and mild. It was Full-Moon on the 28th, the Barometer fell, and ſome Clouds appeared, with a W. Wind. The neareſt Days to the Solſtice were very mild.

The Thermometer was generally between 146 and 150° in the Morning; at Noon it was between 138 and 144°.

Greateſt Height of the Barometer — — —	Inches 30.1 ½
Leaſt — — — — — — — — — —	29.8
Quantity of Rain — — — — — — — —	0.762

July. The ten firſt Days of this Month had the like ſerene Aſpect, though the S W Winds generally prevailed, during that Time the Barometer ſtood conſtantly at above 30 Inches. But afterwards it fell gradually, and Clouds began to ſpread in the N. eſpecially at Sun-riſing.

The laſt Quarter of the Moon was after the Evening of the 5th, and on the following 2 Days the Weſtern Horizon was very red, eſpecially about Sun-ſetting; Wind S W. The New-Moon was after the Evening of the 12th, when there were frequent Coruſcations in the N E. The next Day the S W raged furiouſly about Noon, and the whole Sky was covered with Clouds. After Sun-ſet it was calm again.

On the 14th the Barometer had fallen to 29.8, and broken Clouds appeared here and there. It roſe again to 29.9, and fell again; the Weather was various, and on the 18th the Sky was covered with dark Clouds, it thundered and rained; Wind S S W. There were more frequent Showers on the 3 following Days; eſpecially on the 20th, on the Night before which the Barometer fell to 29.6 ½; Wind S E, and then E.

On the 20th, after Sun-ſet, was the firſt Quarter of the Moon, the Sky being cloudy and rainy; a ſtrong N E by N. Wind roſe, and raged the following Day. The Winds were afterwards more mild to the 25th. The Barometer began to riſe on the 21ſt in the Evening, and continued riſing. A pleaſant Serenity laſted till the latter End of the Month, there being only now and then ſome light Clouds.

On the 27th and 28th the Wind was at firſt S E, then S. and S W, the Barometer fell a little. But on the 28th, 29th, and 30th, a miſty and thick Band darkened the Weſtern Horizon, it being elſewhere clear. On the 31ſt the Miſt was thickened into Clouds, the Barometer ſunk again, a great Shower fell; Wind S E.

The Thermometer roſe to 128 on the 7th, about 2 in the Afternoon; and on the 17th at the ſame Hour got up to 122: Which was the greateſt Degree of Heat in the whole Year, though it roſe alſo to the ſame Degree in *Aug.* The reſt of the Month it ſtood at between 140

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and 143 in the Morning; and generally between 132 and 135 in the Afternoon.

Greateſt Height of the Barometer — — —	Inches 30.0 ¼
Leaſt — — — — — — — — — —	29.6 ½
Quantity of Rain — — — — — — —	3.629

On the firſt Day of this Month, though the Barometer conſtantly roſe, and a N E by N. Wind blew in the Morning, yet, a W. Wind ſucceeding, there fell a little Rain; afterwards the ſame Wind continuing, and ſometimes changing to N W, the fair Weather continued a long Time, there being only a thick Fog in the Morning of the 5th, 6th, and 7th. The Barometer then ſtood at near 29.11; and the Winds were Northerly. On the 9th, the Barometer roſe to above 30 Inches, but fell again to 29.11. On the 12th, 13th, and 14th, the Mornings were foggy; Wind S S W. Auguſt.

The laſt Quarter of the Moon was on the 3d at Midnight, and the New-Moon on the 11th in the Morning; Wind S W.

The S S W, which blew on the 14th, continued intermixt with W. till the 18th. On the 15th the Thermometer was 122 ½, on the 16th 122, at 2 *p. m.* which indicated the greateſt Heat of the whole Year. The Wind blowing gently at S. and W, the Heat abated; and the Barometer falling a little, the Sky was covered with Clouds. But at Night, the Wind changing, the Barometer roſe again, and the fair Weather returned. The next Day the Moon came to the firſt Quarter after Noon.

The fair Weather, with Northerly Winds, laſted till the 23d. But then the S S W ſucceeding, Clouds and Thunder enſued. It rained at Night, the Barometer being at 29.8 ¼. In the Morning the S E reſtored the fair Weather for 3 Days, the Barometer varying but little. Then the Northerly Winds prevailing, eſpecially on the 27th, after a ſhort Rain at Night, accompanied by Thunder, the Air grew cold: The Thermometer fell in the Morning to 149°, and from thence to the End of the Month varied between 148 ½ and 147°.

The Farmers imputed to this Sharpneſs of the Air the Skins of the ripening Grapes being hardened, and the Cluſters ſhrivelled, which before had given Hopes of a plentiful Vintage.

In the mean Time the Barometer roſe to 29.10 ½; Wind N E by E: But on the laſt Day of the Month it fell a little, and the Sky was covered with Clouds about Noon.

Greateſt Height of the Barometer — — —	Inches 30.0 ¾
Leaſt — — — — — — — — — —	29.8 ¼
Quantity of Rain — — — — — — —	0.486

On the firſt 5 Days of this Month the Weather was various, ſometimes fair, and ſometimes cloudy. Several little Clouds frequently ap- September.

peared in the Northern Part of the Sky in the Morning. The Wind was generally N E by E. at Sun-riſing, and S. about Noon. The Barometer varied between 29.8 and 29.10, and though on the 5th in the Evening it roſe to 29.11, it fell again a little at Night, and the next Day it rained with a S W Wind. We obſerved the ſame on the 8th, when after Rain in the Afternoon and Thunder, the N E and E. Winds prevailed, and the fair Weather returning laſted till the 12th.

On the 2d the Moon came to the laſt Quarter, Wind S S W. On the 9th, New-Moon; Wind N W.

The 12th was fair almoſt the whole Day; Wind N E by E, and then W. The Barometer fell gradually. At Night the Sky was a little cloudy; Wind S E. Next Day, the Wind blowing from the ſame Quarter, and the Barometer falling gently to 29.9, there fell a great Shower, amounting to almoſt 2 Inches. Next Night the N E Wind brought Clouds, and the Barometer roſe half a Line. The fair Weather laſted to the End of the Month, being ſometimes interrupted by Clouds. There were frequent Miſts alſo, eſpecially on the 23d, 24th, 25th, and 30th, at Sun-riſing. The Moon came to the firſt Quarter, with a S. Wind and fair Weather before Sun-riſing on the 17th, and was at the Full on the 25th before Sun-riſing, with the ſame Wind.

After the 20th, the Barometer varied but little from 20 Inches. In the Morning the Winds blew between N. and E. generally, ſeldom between S and W. This State of the Atmoſphere accompanied the Days neareſt to the autumnal Equinox, the Barometer keeping at about 30 Inches. About the latter End of the Month Wind N N E.

The Thermometer ſhewed various Degrees of Heat and Cold, both in the Morning and Afternoon. For on the 3 firſt Days, at Sun-riſing, it was between 140 and 142°; at Noon between 130 and 133°. Afterwards it varied very much, for at Sun-riſing it was often at 152, and ſometimes at 153 ½. After Noon it was generally between 134 and 138; about the End of the Month it roſe to 126 ½, which was the greateſt Heat of the whole Month, Wind W.

Greateſt Height of the Barometer — — —	Inches 30.1 ¼
Leaſt — — — — — — — — — — —	29.7 ⅓
Quantity of Rain — — — — — — — —	2.605

October. This Month was very remarkable for Novelties. The laſt Quarter of the Moon was on the 1ſt Day, after Sun-ſet, Wind N E by E, Weather fair. The N N E Winds, which prevailed at the latter End of laſt Month, continued alſo at the Beginning of this. The W. Winds ſucceeded till the 12th. The Barometer ſtood at a little above or below 30 Inches: But on the 8th at Night it roſe to 30.4 ¼.

The ſame Night, the Sky being clear, 4 Hours after Sun-ſet there was an *Aurora Borealis*, which overſpread the whole Sky from N. to W. with a remarkable Redneſs. The Houſes hindered me from ſee-

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ing quite to the Horizon. An Hour afterwards, the Redneſs gradually changed to whitiſh: A little afterwards the Light was extinguiſhed, and returned again, but fainter toward the W. In a little Time it quite diſappeared. The Wind blowed gently from the W. the Thermometer was at 148°.

This Northern Light was ſeen an Hour after Sun-ſet, in the *Placentine*, but in a different Form. It declined a little from the N. toward the W, and illuminated a third Part of the Heavens with a whitiſh Light. Very thin Clouds, like ſtanding Pillars, aroſe from the Horizon, but did not intercept the Light of the fixt Stars, or ſenſibly vary. The white Brightneſs continued all Night: But about Day-break it grew red, and declined a little toward the E. Thus in the E. the Sky ſhone with the natural Light of the Dawn; but in the N. with the Red of full Day-break: And ſo was illuminated with a double Light at once. The next Evening it was ſeen again from 9 till 4 Hours after Sun-ſet. Then upon the Diſappearance of this Light, a darker Night than uſual ſeemed to ſucceed. At *Rome*, though the Sky was clear, and it was New-Moon that Night, we did not obſerve any Trace of an an unuſual Light.

From the 9th the Barometer fell gradually, the fair Weather and Weſt Wind continuing. But on the 12th about Noon, this Wind darkened the Sky with very thick Clouds. Then the Barometer ſinking to 29.11 ¾, there fell a great Shower, of almoſt 2 ½ Inches.

A little after Sun-ſet, the fair Weather returned; and the next Morning Clouds were ſeen only at the Northern Horizon, Wind S E. The Evening being fair, the Barometer roſe to 30.0 ¾, though the S W blew, and then the S.

In the Morning of the 14th, Wind S W, and about Noon S, after Noon it rained. The next 2 Days it rained, Wind ſometimes S, and ſometimes N E. On the 16th, which was the Day before the firſt Quarter, there was Thunder and terrible Lightning, accompanied with Rain: But in the Evening the fair Weather returned. The Barometer kept ſteady at 29.10 ½ till the 19th, when it fell a little at Sun-ſet. The next Night ſome Showers began to fall, which continued to the End of the Month, the Barometer being generally above 29.9. They were very heavy on the 21ſt, 23d, and 24th; and what is very obſervable, on the 23d, there fell near 6 Inches of Rain in about 6 Hours, with a very ſtrong S. Wind, accompanied with Thunder, Hail, and Lightning. The Barometer had fallen that Day to 29.6 ½, and the Thermometer was at 149°. On the 24th it rained an Inch, though the Barometer had riſen a little. Next Night it was Full-Moon. The reſt of the Month the Barometer continued to riſe a little, the Weather was various, but generally cloudy; Wind N. mixt with E.

The Thermometer generally kept between 151 and 154 in the Morning: At Noon between 139 and 144. But on the laſt Days of the

Month it was between 156 and 160 in the Morning: At Noon between 151 and 152.

Greateſt Height of the Barometer — — —	Inches 30.4 ¼
Leaſt — — — — — — — — — —	29.6 ½
Quantity of Rain — — — — — — — —	10.895

November. The N E and neighbouring Winds blew almoſt all this Month, with various Weather. The Barometer conſtantly kept at above 29.10, except on the 7th and 8th, when it fell to 29.8 with a S E Wind, and a great Shower fell on the 8th, when it was New-Moon after Noon. But the Barometer recovering it's former Elevation, and exceeding it on the 16th, when the Moon had paſſed the firſt Quarter, it roſe to 30.4 ⅓, with a N E Wind. This Height of the Barometer fell very little ſhort of the greateſt Height of this Year.

On the 17th and 18th, at Sun-riſing, the Thermometer was at 170 and 171, with a clear Sky and N E Wind. Then on the 20th and 21ſt, the Barometer fell haſtily to 29.8 ⅓, with Rain, Thunder, and Lightning, Wind S. The Thermometer was then between 155 and 161. On the 22d, after Sun-ſet, the Moon being at full, and the Barometer at 30.2, the fair Weather returned, and the Thermometer fell in the Morning to 166°. But the Barometer fell a little, and it rained again. Then after 2 Days of fair Weather (when a cold Air and N E Wind in the Morning had ſunk the Thermometer to 174 ½) Wind N E by E. to the End of the Month, either Clouds or Rain. On the 28th the Barometer fell remarkably to 29.1 ¼. But in a ſhort Time, the ſame Wind continuing, it roſe again; and the Moon was in the laſt Quarter on the 29th at Night.

This Month therefore the Barometer fell from a remarkable Height, almoſt to the loweſt, in a Space of 12 Days.

Greateſt Height — — — — — —	Inches 30.4 ⅓
Leaſt — — — — — — — — — —	29.1 ¾
Quantity of Rain — — — — — — — —	3.488

December. The N E Winds which prevailed laſt Month, continued till the 20th of this: The Sky was generally clear, except on the firſt 6 Days, in which the Barometer varied between 30 and 29.9, though a little Rain accompanied it's falling. On the other 14 Days it was but little above or below 30. On the Morning of the 8th (Full-Moon) and on the 10th and 11th it roſe to 30.2. After the 15th, which was the firſt Quarter of the Moon after Noon, it fell a little from the Height of 30.1 ⅓, and the Sky appeared cloudy.

The Thermometer, which a little before Sun-riſing on the 2d, was at 174, kept on the following Days till the 11th at the ſame Hour between 165 and 170. But the Cold increaſing, it ſtood on the 13th at 174 ½, and then the Cold abated.

On

On the 20th about Noon, the S. Winds began to blow, the Sky to be darkened, and the Barometer to fall. This Deſcent being more precipitate the following Night, amounted to above 3 Lines, being at 29.5 ½ in the Morning. Before Noon on the 21ſt, it thundered, a ſtrong S. Wind blew, and a large Shower fell.

On the 22d before Noon it rained again, Wind S W, Full-Moon. And becauſe the Winter Solſtice happened on the 21ſt at Sun-ſet, the Winds which prevailed on the neareſt Days to that Solſtice, were for the moſt Part S. mixed with S W, S E, and E; then the Sky was rainy to the End of the Month; Winds S E and E; and on the 26th alone there fell above 3 ½ Inches of Rain, the Barometer being at 29.10 ½. But when it came on the 28th to almoſt 30 Inches, another Inch of Rain fell on the ſucceeding Night; and it rained again the next Night, when the Moon came to the laſt Quarter. At this Time there fell many Showers, the Thermometer being at 161 in the Morning, and the Air very mild.

Greateſt Height of the Barometer — — —	Inches 30.2
Leaſt — — — — — — — — — — — —	29.3 ½
Quantity of Rain — — — — — — — —	8.501

General Obſervations on the Meteorological Diaries for 1741.

Since in *Feb.* the Barometer was at it's greateſt Height, 30.5, and in *Jan.* at it's leaſt, 21.5, the Scale of the Variations of the Barometer this Year was 16 Lines, or 1 ⅓ Inch; and the mean Height 29.9.

In *Jan.* alſo the greateſt Cold of the whole Year was indicated by the Thermometer being at 180; and in *July* and *Aug.* the greateſt Heat by it's being at 122. Therefore the Scale of the Variations of the Thermometer was 58°, or ſo many of thoſe Parts, of which the whole Capacity of the Thermometer contains 5000. Therefore taking from this laſt Number 122 Parts, which the Quickſilver did not occupy in the greateſt Heat; it's Bulk at that Time was only 4878 Parts; and it loſt 58 of theſe Parts in the greateſt Cold. Or if we divide the Bulk of the Quickſilver increaſed by the greateſt Heat into 1000 Parts, then 11 ⅛ of thoſe Parts will have been loſt in the greateſt Cold. For there is nearly the ſame Proportion between 4878 and 58, as between 1000 and 11 ⅛.

The Quantity of Rain that fell this Year was Inches 43.780. Now from the Obſervations of the former 8 Years, the mean Quantity of Rain was 34 Inches; and in 1737, which exceeded the reſt in Quantity of Rain, there fell only 36.788. Therefore the Rain of 1741 exceeded the Mean by 9.780; and the greateſt of 1737, by 6.992. It muſt by no Means be omitted, that in the 3 laſt Months of the Year alone there fell 22.884, which not only exceeded half the Quantity of Rain of this whole Year, but ⅔ of the mean yearly Rain. The greater Quantity of Showers this Year fell therefore in the 3 laſt Months.

The Showers alſo of *July*, which meaſured 3.629, were very unuſual; for ſince our Application to theſe Obſervations, we have never perceived

perceived a whole Inch of Water to fall in that Month. And this perhaps was the Cauſe, that the Summer Fruits very much abounded with Worms this Year: As the Huſbandmen aſcribed alſo the great Number of Worms, which injured the Olives, to the too great Abundance of autumnal Showers.

Another unuſual Phænomenon alſo accompanied the autumnal Rains: For many and long Showers fell, when the Barometer was riſen not a little above the mean Height. Though it muſt be acknowledged, that the Barometer generally fell a little from a greater Height before the Deſcent of Showers.

In this Year, as in others, the NW Winds were ſeldom obſerved to blow; and the E. Winds moſt frequently about *Rome*. The E. and S. Winds generally brought Clouds or Rain, and the N. and W. Winds fair Weather: Sometimes, but very ſeldom, the contrary.

The Winds which blew moſt frequently on the neareſt Days to each Solſtice, frequently prevailed in the following Seaſon. We obſerved the ſame alſo, with regard to the Winds near the Equinoxes, but not altogether ſo ſenſibly. This Obſervation *Blanchini* has obſerved to hold for a long Courſe of Years, and I have found it ſeldom to vary.

When the Weather was calm, eſpecially in Summer, the E. Winds were generally obſerved to blow gently in the Morning, the S. about Noon, and the W. at Night.

The magnetical Needle varied this Year from N. to W. 15°, 40′. The Increaſe of Variation therefore from 1730, was 4°. 40′. For the Variation that Year was 11°.

The following Obſervations on the epidemical Diſeaſes of this Year were made by *S. Leprotti*, Chief Phyſician to the Pope, and *F. R. S.*

In the Winter ſome few had Inflammations in the Breaſt; but many had Catarrhs, Inflammations of the Tonſils, and rheumatical Diſorders. About the End of *January* alſo, ſome petechial malignant Fevers began, eſpecially among thoſe who lived near the *Tiber*; many who lived in the ſame Houſe being ſeized by them at the ſame Time. Theſe Fevers were continual, and did not at all intermit; but they all came on like thoſe, which approached moſt to the Nature of Tertians, being alternately one Day more vehement than another. Theſe were accompanied, among other Symptoms, by a vehement Pain of the Head, which was ſucceeded by a Drowſineſs and Diarrhœa. They were cured by bleeding, and the Uſe of Diluents, and the Bark, without any Emeticks or Purgatives, which ſome make Uſe of on theſe Occaſions.

About the End of the Spring, theſe Fevers were ſucceeded by regular Intermittents; which for the moſt Part were favourable, but attended generally by grievous Head-achs: And theſe alſo were cured by bleeding and the Bark. This Sort of Fevers has continued through the Summer and Autumn, to the preſent Winter.

In the Summer ſome were attacked by a Diarrhœa and Cholera. Some ſpurious Inflammations of the Breaſt, and Catarrhs have appeared

this

this Winter: But the above-mentioned intermitting Fevers are moſt epidemical.

In the 2 laſt Months of the Year many fell ill ſuddenly, ſome of Apoplexies, others of internal Diſorders of the *Præcordia.* Laſtly, it is worthy of Obſervation, that Diſeaſes ariſing from Worms were frequent in Summer and Autumn, which in ſome acute Caſes were thrown off by vomiting and purging. This was chiefly obſervable in the Country People.

LXI. 1. The Mildneſs of the preceding Winter produced epidemical catarrhal Fevers in *Feb.* and *March.*

March 14, the Cold was unuſually ſevere, and was brought by an impetuous N E Wind, which blew 2 Days before.

May 5, the Cold of the Night injured the Vines and Wallnuts, and ſcorched the Corn, eſpecially in low Places; ſo that the Ears were afterwards empty.

F. R. S. No. 441. *p.* 238. Apr. &c. 1736.

Some Meteorological Obſervations made at Wittemberg *in* 1733, *by* Joh. Fred. Weidler, *Prof. Math. Pr. and*

2. *Feb.* 17, the Barometer was at 28.7, which is lower than I ever obſerved it before. It predicted a moſt horrid Storm, and Violence of the Wind, which at 3^h *p. m.* blew a great Number of Tiles off the Houſes, ſo that it was very unſafe walking in the Streets. This Storm did great Miſchief, in *Saxony* and other Parts of *Germany*, to the Buildings, Woods, and Gardens, broke old Oaks and other Trees, and blew down ſeveral Perſons in the open Fields.

An Obſervation made in 1734, *by the ſame.* No. 442. *p.* 269. July, &c. 1736.

LXII. In *Jan.* there fell 131 Meaſures of Rain, 111 in *Dec.* and 108 in *Oct.* but in *March* and *May* it rained very little. Thus on comparing the Seaſons together, we find Winter and Autumn the moſt rainy, and Spring and Summer the moſt fair, eſpecially Spring. This is common in our Country, and ſeems to be moſt agreeable to the Temperature of the Air, and to a hot and dry Seaſon of the Year. It may ſeem ſtrange, that at *Paris* the greateſt Quantity of Rain ſhould fall in *July*, *Aug.* and *Sept.* as it has been conſtantly obſerved by M. *de la Hire.* Perhaps it may be owing to the Situation of that Country, which has the Sea to the N. and W. and to the Diſpoſition of the Air, that ſuch Storms, as are attended by copious Showers, are more plentiful there in Summer. But we, who are waſhed by the *Tyrrhene* Sea on the S. and W. and ſurrounded by the *Apennines* on the S. and E. have fewer of thoſe rainy Storms: For the Vapours being raiſed from the Sea in greater Quantity by the hot Summer Sun, being carried to the Land, may produce more copious and frequent Rains in the Northern and Champain Country of *France*: But on our Coaſts, the Vapours riſing in leſs Quantity from the *Tyrrhene* Sea, will ſupply leſs Matter for Rain in Summer; eſpecially as the *Apennine* Mountains and the Winds blowing againſt them at that Seaſon from the Midland Countries, will eaſily repel them, when they are brought towards the Land. From this mutual Strife of the Winds from Sea and Land we are ſub-

A Phyſical Hiſtory of the Air and Earth for 1732, *by* Nicholas Cyrill, *firſt Prof. of Phyſick in the Univerſity of* Naples, *and F. R. S.* No. 430. *p.* 184.

ject to thoſe Summer Storms, called by our People *Tropee*, which are remarkable for Thunder and Lightning, rather than for much Rain.

The Snow, which lay deep upon the Mountains about the End of 1731, ſtill remained upon them in *Jan. Feb.* and *March* 1732, the old Snow being continually increaſed by the falling of new. We often obſerved even *Veſuvius* to be covered with Snow: But it ſeldom lay in the City, and adjacent Country. It froze only on the 29, 30, and 31 Days of the laſt Year; the firſt moderately, the ſecond more, and the third leſs, when it thawed after Noon. *Hauksbee*'s Thermometer was at 57; the firſt 2 Days it was calm, but on the 3d the Wind was N W. At the End of *November* and Beginning of *December* it froze in the City, firſt more, and then leſs. It hailed *Feb.* 23 near the City: *March* 4, in the City: *Apr.* 4, and after the 20th, it was obſerved in the Mountains. *Sept.* 14, at *Foggia*, there was a Whirlwind and Hail, which did Miſchief to Men and Cattle in the open Fields.

The Strength of the Winds was various, and they were often oppoſite. In Winter the W. generally prevailed, turning ſometimes to the S. and ſometimes to the N. which is very common with us, who have the Sea on that Side. The N. Winds blowed ſeldom; but *Jan.* 1 and 2, there was a very ſtrong N E, and then abating a little, and changing to the N W, the Mountains were ſprinkled with Snow.

In this Place it may be proper to animadvert on the Inſtrument for obſerving the Strength of Winds, deſcribed in the *Philoſophical Tranſactions* *; which is not only uncertain, but falſe. A tranſverſe moveable Wing is hung to a common Weathercock, and a Quadrant divided into Degrees is placed near it. When there is no Wind, the Wing hangs perpendicular; but it is raiſed by the blowing of the Wind, and according to the Strength of the Wind it riſes more or leſs, and ſhows the Degrees of Strength on the Quadrant. But this is evidently falſe; for the Wind may be raiſed 10 or more Degrees from it's perpendicular Situation by a very ſmall Strength of Wind: And the more it recedes from the perpendicular, the more the Difficulty of the Elevation of the Wing increaſes: So that if in the firſt Elevation of the Wing, 2 Degrees of Strength of the Wind are ſufficient to go over 10 Degrees of the Quadrant; then 4 Degrees of Strength will hardly be able to acquire 10 Degrees more of the Quadrant; and ſo the Strength of Wind augmented to the 6th and 8th Degree will hardly be ſufficient to raiſe the Wing to the 30th Degree of the Quadrant. Whence it appears, that we cannot uſe this Machine to meaſure the Strength of the Wind exactly; becauſe the proportional Increaſe of it will not anſwer to the Degrees marked on the Quadrant. It will be better therefore to make uſe of Dr *Jurin*'s Method of meaſuring the Strength of the Winds, as I have done in my Obſervations †.

* Vol. II. Chap. 1. §. xvii. † Vol. VI. Part ii. Chap. 1. §. xxxvii.

The

The Quickſilver in my Barometer fell once, *May* 20, to Inches 28.82, *London* Meaſure, which was the greateſt Sinking that Year: And though the Liquor of the Thermometer differed not a little from it's greateſt Rarefaction, yet People were almoſt ſuffocated by the Heat. On the contrary, the greateſt Height of the Barometer, 29.38, was *Dec.* 10, the Wind blowing 2 Degrees at E. the Air being dry and cold, and *Veſuvius* raging furiouſly. But that whole Month the Height of the Quickſilver was conſtantly obſerved to be greater than in the other Months of the Year; but *Nov.* 20, 21, 23, and *Dec.* 16 and 17, it came to 29.30. The mean Height of my Barometer is 29 4. Though the Aſcent of the Quickſilver generally denotes fair Weather and Northerly Winds, as it's Deſcent on the contrary uſually accompanies impending Rains and Southerly Winds; yet the contrary often happens. Hence ſome may perhaps conclude, that not ſo much the various Weight of the external Air, as ſome Alterations of the Quickſilver itſelf may conduce to the various Motion of the Quickſilver in the Barometer.

The Thermometer, which was one of *Hauksbee*'s, afforded the following *Phænomenon*. The greateſt Heat of this Year was from *July* 9 to the Beginning of *Aug.* The Heat came to the greateſt Height *July* 17, 23, and 24, the Liquor riſing to 4. This Aſcent uſed to happen in former Years: But what was peculiar in this Year, was the greateſt Heat continuing almoſt equal Day and Night for 22 Days: The Liquor keeping about 5, 6, 7, and 8, except *July* 16, when the S. and N N W Winds blowing by Turns, with Thunder, it rained at Times to the Height of almoſt an Inch, when the Thermometer fell ſuddenly from 8 to 20.

The greateſt Cold was obſerved at the End of laſt Year, and Beginning of this, the Thermometer falling to 56 and 57, when there was Snow on the Mountains, and Froſt in the City. In *Dec.* when there was Ice ſeen, the Thermometer fell to 55 and 56. Here I think it proper to obſerve, that in the Table put to *Hauksbee*'s Thermometer, *Froſt* is ſet at the 65th Degree. But I have found from the Obſervation of ſeveral Years, that it has frozen, when the Thermometer ſent to me fell only to 55. Whence it is plain, that Freezing requires a ſmaller Degree of Cold at *Naples* than at *London*. This *Phænomenon* will be the Subject of a particular Diſcourſe, when I ſhall have made ſome more accurate Experiments.

I ſhall now mention ſomething about our *Veſuvius*. It was ſilent almoſt the whole Year: But at the latter End, after *Dec.* 9, it began to emit Smoak with Violence in the Day, and ſometimes Flame in the Night. On the 20th both Smoak and Flame increaſed greatly. Hence on the following Days there was an inward Grumbling and Noiſe, like the Exploſion of Cannon, which was heard at the Diſtance of ſeveral Miles; ſo that the Windows and Shutters ſhook. Burning Stones were thrown on high from the *Crater* of the Mountain, which afterwards falling down, and ſticking to the Sides of the Hill, afforded a beautiful,

though terrible, Spectacle to our City, and to Places more remote. The Aſhes were ſcattered over the neighbouring Parts farther or nearer, according to the Determination and Strength of the Winds. From *Dec.* 27 and 28 a very thick Smoak, riſing not very high, overſpread the neighbouring Places thick with Aſhes. After *Dec.* 29, the Smoak and Noiſe gradually decreaſed: And after *Jan.* 4, all was quiet.

We were told, that *Ætna* at the ſame Time vomited forth a great Quantity of Fire and Smoak, with Noiſe: And that *Stromboli* thundred with an unuſual Noiſe, and threw forth a violent Flame: So that the frequent Rumbling of the Iſland, and Flames burſting out with Noiſe, ſeemed to the Inhabitants of the Weſtern Part of *Campania*, as if two Navies had been engaged in Fight.

This Year was unfruitful in Corn, except Maiz; but produced great Plenty of all Sorts of Fruit; and the Wine was in greater Quantity and more delicious than in the preceding Year.

An Account of Mr Sutton's *Invention and Method of changing the Air in the Hold, and other cloſe Parts of a Ship; communicated to the* Royal Society, *by* R. Mead, *M. D. Phyſician to his Majeſty. F. R. S. and* Reg. Coll. Med. Lond. No. 462. *p.* 42. *Read* Feb. 11. 1741-2.

LXIII. 1. It is found by daily Experience, that Air ſhut up and confined in a cloſe Place, without a Succeſſion and freſh Supply of it, becomes unwholſome, and unfit for the Uſe of Life. This is more ſenſibly ſo, if any ſtagnating Water be pent up with it. But it grows ſtill worſe, if ſuch an Air as this is made uſe of in Reſpiration, that is, becomes moiſter and hotter, by paſſing and repaſſing through the Lungs.

Theſe bad Effects, in different Degrees, according to the different Manner in which Air is incloſed, are obſerved in many Caſes; particularly in deep Wells and Caverns of the Earth, in Priſons or cloſe Houſes, where People are ſhut up with Heat and Naſtineſs: But moſt of all in large Ships, in which, with the Stench of Water in the Hold, many Men being crouded up in Cloſe-quarters, all the mentioned Circumſtances concur in producing greater Miſchief than would follow from any of them ſingle.

The Reaſon of theſe bad Effects is this: It is that Property of the Air which is called it's Elaſticity or Springineſs, which makes it ſo uſeful to our Life. When any Part of it is incloſed and kept from the Communication of the outward Air, it expands itſelf, and, in Proportion to the Cloſeneſs of the Place, loſes it's Spring; and if any Heat or Moiſture comes to it, the elaſtic Force may be quite loſt and deſtroyed: And not only ſo, but if it happens to be impregnated with noxious *Effluvia*, either from unwholſome Subſtances of any Kind, or from the infectious Breath of diſeaſed Bodies; it will become quite poiſonous and deadly, in a Manner ſuitable to the original Cauſe.

It is propoſed at preſent to find out a Remedy for this Evil in Ships only: But by making Alterations according as particular Places require, the ſame may be applied to any Houſes or Parts of them, as Priſons, the ſick Wards in Hoſpitals, *&c.* Now it is a natural Conſequent of the Elaſticity of the Air, that when it is rarefied in any Part, (which is moſt effectually done by Heat) the neighbouring Air will ruſh that Way, till this Part is brought to be of an equal Denſity and Elaſticity with

with itſelf; and this again will be followed by the Air next to it: So that, if a Conveyance for Air be laid from the Hold or Well of the Ship, and a Rarefaction of the Air therein be made; the foul Air from this Place will run or be drawn out that Way, and freſh Air from the adjacent Parts will ſucceed in it's Room.

It is upon theſe Principles that the following Scheme is moſt humbly offered to the R. Hon. the Lords of the Admiralty, and Commiſſioners of the Navy, which it is hoped will be found effectual for clearing the bad and corrupted Air from the Holds and other cloſe Parts of his Majeſty's Ships; and thereby prove beneficial to the Publick, by preſerving the Healths of many of his Majeſty's good Subjects ſerving on board the ſame; the whole Thing being indeed eaſy to be executed, and what will no Ways incumber, or be troubleſome, in any of the Veſſels where it ſhall happen to be applied; the ſame being, in ſhort, no more than this: That whereas in every Ship of any Bulk there is already provided a Copper or Boiling-place proportionable to the Size of the Veſſel, it is propoſed to clear the bad Air by Means of the Fire already uſed under the ſaid Coppers or Boiling-places, for the neceſſary Uſes of the Ship.

It is well known, that under every ſuch Copper or Boiler, there are placed two Holes ſeparated by a Grate; the firſt of which is for the Fire, and the other for the Aſhes falling from the ſame; and that there is alſo a Flue from the Fire-place upward, by which the Smoke of the Fire is diſcharged at ſome convenient Place of the Ship.

It is alſo well known, that the Fire once lighted in theſe Fire-places, is only preſerved by the conſtant Draught of Air through the fore-mentioned two Holes and Flue; and that if the ſaid two Holes are cloſely ſtopped up, the Fire, though burning ever ſo briſkly before, is immediately put out.

But if after the ſhutting up the above-mentioned Holes, another Hole be opened, communicating with any other Room or airy Place, and with the Fire; it is clear, the ſaid Fire muſt again be raiſed and burn as before, there being a like Draught of Air through the ſame, as there was before the ſtopping up of the firſt Holes: This Caſe differing only from the former in this, that the Air feeding the Fire will now be ſupplied from another Place.

It is therefore propoſed, that in order to clear the Holds of Ships of the bad Air therein contained, the two Holes above-mentioned, that is, the Fire-place and Aſh-place, be both cloſed up with ſubſtantial and tight Iron Doors; and that a Copper or Leaden Pipe, of ſufficient Size, be laid from the Hold into the Aſh-place, for the Draught of Air to come in that Way to feed the Fire. And thus it ſeems plain from what has been already ſaid, that there will be from the Hold a conſtant Diſcharge of the Air therein contained; and conſequently, that that Air ſo diſcharged muſt be as conſtantly ſupplied by freſh Air down the Hatches, or ſuch other Communications as are open into the Hold; whereby

whereby the ſame muſt be continually freſhened, and it's Air rendered more wholſome, and fit for Reſpiration.

And if into this principal Pipe ſo laid into the Hold, other Pipes are let in, communicating reſpectively either with the Well or lower Decks, it muſt follow, that Part of the Air conſumed in feeding the Fire, muſt be reſpectively drawn out of all ſuch Places, to which the Communication ſhall be ſo made.

Some Obſervations upon the ſame, with critical Remarks upon the Uſe of Windſails, by William Watſon, *F. R. S.* No. 463, *p.* 62. *Read* April 1, 1742.

2. As nothing is more conducive to the Health of the human Body, than taking a ſufficient Quantity of wholſome Air into the Lungs, ſo the contrary is attended with pernicious and often with deſtructive Conſequences.

One of the great Uſes of Air in Inſpiration is, to cool the Blood paſſing through the Lungs, where Nature has provided, according to the excellent *Malpighius*, that the Blood ſhould be diſtributed through a vaſt Number of exceedingly fine Arteries, which are applied all round the thin Veſicles of the Lungs; and by this Means the Blood is expoſed to the Air under a prodigious large Surface, whereby the Putrefaction is prevented, which, from the alcaleſcent Quality of that Fluid, would otherwiſe be ſpeedily deſtructive.

Obſervations inform us, that contagious Diſtempers are more frequent in hot Climates than cold; and in cloſely built Cities fully inhabited, than in Towns: The former may, in ſome Meaſure, proceed from the too great Heat of the Air, not fully anſwering the above-mentioned Purpoſes; and the latter from too many People breathing in the ſame Atmoſphere, thereby rendering it unfit for Reſpiration.

It has been frequently tried, that if a Gallon of Air be contained in a Bladder, and by Means of a Blow-pipe inſpired and expired into the Lungs of a Man, without having any Communication with the external Air; in the Space of a Minute, or little more, it becomes heated, and unfit for Reſpiration; and without the Addition of freſh Air, the Perſon would ſpeedily be ſuffocated. The Diving-bell is another Inſtance of the ſame Kind, where a conſtant Supply of freſh Air muſt be had, to keep out the Water, and refreſh the People included.

Although Air is abſolutely neceſſary to our Exiſtence, and Neceſſity conſtrains us inevitably to breathe therein, it may be made a Vehicle of moſt malignant Poiſons, as the famous *Grotto del Cani* in *Italy*; poiſoning Air by Charcoal, Air impregnated with the Fumes of fermenting vegetable Liquors, ſtagnant Air, either alone or mixed with Water, ſoon becomes pernicious, and very offenſive; as in Wells digged for Supply of Water, and diſuſed for ſome Time; alſo in the Wells and in the Holds of Ships, where what is uſually called the Bulge-water, if the Ship is tight, and the Water not pumped out often, ſoon becomes ſo extremely poiſonous, as frequently to ſuffocate thoſe Seamen, who, as the Pumps are ſubject to be clogged with Filth, venture down to cleanſe them; and alſo to affect Perſons at a Diſtance with violent Head-

achs,

achs, cold Sweats, and frequent Vomitings, which continue more or leſs, in Proportion to the Diſtance from the Well of the Ship when the Injury was received, and the Degree of Putrefaction in the Water and Air.

The Air, in Ships particularly, is very liable to be vitiated; not only from the Bulge-water, but from too many People breathing in the ſame Atmoſphere; eſpecially in Ships of War, Hoſpital-Ships, and thoſe uſed in the *Guinea*-Trade for *Negroes*, where a Number of uncleanly People, being ſtowed too cloſe together, heat the Air, make it replete with noxious *Effluvia*, deſtroy the Particles therein adapted to cool the Lungs, particularly the acid nitrous *Gas*, which is ſo abundant in cool Air, and manifeſts itſelf not only from the Quantity of nitrous Cryſtallizations, which may be collected from Caverns of the Earth, eſpecially thoſe open to a Northerly Aſpect, but from expoſing Pieces of the Fleſh of Animals freſh cut, or their Blood, whereby the Colour of their Surfaces are ſoon changed from a dark deep Red to a more lively and florid one. Air robbed of this valuable Property, and replete with hurtful ones, not only from the People, but from the ſtinking Water in the Well and lower Parts of the Ship, muſt produce the moſt putrid, if not peſtilential Fevers.

Although the *Æquilibrium* within Places confined is maintained by the external Air, yet unleſs, by Openings properly adapted, the Air is ſuffered to paſs freely through, the external Air proves as a Stopple to the internal, and only mixes with the next in Contact; as is evident from the common Occurrence in Privies, which are ſcarcely offenſive in clear Weather, but are much ſo in foul or windy, from a Diminution of the incumbent Preſſure, when the Vapours that have been pent up, expand themſelves to a conſiderable Diſtance.

To prevent the above-mentioned Inconveniencies, and preſerve the Healths and Lives of that valuable Part of the Nation, the Seafaring People, many Schemes have been thought of; particularly the Machines of thoſe two very worthy ingenious and induſtrious Members of this Society, the Rev. Dr *Hales*, and the Rev. Dr *Deſaguliers*; the firſt by an Inſtrument which he calls *The Ship's Lungs* *, and the latter by a Machine †, which is an Improvement of the *Heſſian* Bellows: But as theſe have been laid before the Society by the Gentlemen themſelves, I ſhall paſs them over, and proceed to mention the Contrivance commonly made uſe of, I mean the Windſails. They are made of the common Sailcloth, and are uſually between 25 and 30 Foot long, according to the Size of the Ship, and are of the Form of a Cone ending obtuſely: When they are made uſe of, they are hoiſted by Ropes to about two Thirds or more of their Height, with their Baſis diſtended circularly by Hoops, and their Apex hanging downwards in the Hatchways of the Ship; above each of theſe, one of the common Sails is ſo diſpoſed,

* See Dr *Hales*'s Treatiſe of Ventilators. † See theſe *Tranſactions*, No. 437.

that the greateſt Part of the Air, ruſhing againſt it, is directed into the Windſail, and conveyed, as through a Funnel, into the upper Parts of the Body of the Ship. Theſe muſt be hung up and taken down every Time they are uſed, and the Supply by this Method is not conſtant. Though Cuſtom has given a Sanction to this Device, it is ſubject to many Inconveniencies: 1*ſt*, Each Ship having commonly three of theſe, (one to each Maſt) the Seamen are a conſiderable Time in getting their Apparatus ready, and hoiſting them up, to make uſe of. 2*dly*, They can only be uſed in mild Weather. 3*dly*, Near the Equator, where freſh Air is moſt wanted, there ſometimes happen ſuch ſtark Calms, that they are uſeleſs by not having Air enough to diſtend them. 4*thly*, The Air hereby admitted paſſes only into the upper and more open Parts of the Ship, ſo that the Well, *&c.* receive no Change therefrom; and it is obſerved, that ſometimes, upon uſing them after ſome Diſcontinuance, they drive offenſive Air into the Cabin, and more airy Parts of the Ship; like as the pouring ſome freſh into ſtinking Water makes more Water ſtink, though in a leſs Degree. 5*thly*, They are improper to be uſed in the Night-time, when the People are ſleeping between Decks. And, *laſtly*, admitting they had none of the former Inconveniencies, their Uſe muſt be deſtructive in Hoſpital-Ships; where, though freſh Air imperceptibly received is abſolutely neceſſary to preſerve the Crew as free as poſſible from the infectious Breath and Exhalations of the diſeaſed and wounded Seamen, yet Blaſts of Wind, pouring impetuouſly into the very Places where the Sick lie, muſt be attended with ſuch Conſequences as are too obvious to mention.

To remedy theſe Inconveniencies, to prevent Air proving foul even in the Wells and Holds of Ships, and to cauſe imperceptibly a large Circulation of freſh Air into every Part of the Ship at all Times, Mr *Sutton* has invented this Scheme, which is uſeful not only in theſe Caſes, but, by altering ſome Parts, as particular Places require, may be applied to Houſes, cloſe Parts of Priſons, Wells at Land, Privies, Hoſpitals, *&c.*

Nothing rarefies Air ſo conſiderably as Heat, and whenever it cauſes a Diminution of the Denſity of the Air, that Part next in Contact will ruſh in, and be ſucceeded by a conſtant Supply, till the Air becomes of an equal Degree of Elaſticity. Therefore, if a Tube be laid in the Well, Hold, or any other Part of the Ship, and the upper Part of this Tube be ſufficiently heated to rarefy the impending Column of Air, the *Æquilibrium* will be maintained by the putrid Air from the Bottom, which being drawn out this Way, a Supply of freſh Air from the other Parts of the Ship will ſucceed in it's Place; which Operation being continued, will entirely change the Air in all the Parts of the Ship. This Principle, exactly conformable to the Doctrine of Pneumatics, is the Baſis of Mr *Sutton*'s Machine, which being put in Execution on board the *Hulk* at *Deptford*, before the Lords of the Admiralty, Commiſſioners of the Navy, *M. Folkes*, Eſq; Dr *Mead*, &c. performed to their

their Satisfaction, in bringing Air from the Bread-room, Horlop, and Well of the Ship at the ſame Time, in ſuch Quantity, that large lighted Candles being put to the End of Tubes, the Flame was immediately ſucked out as faſt as applied, though the End of one of the Tubes was above 20 Yards diſtant from the Fire. The Method is as follows:

To boil the Proviſions of the Ship's Company, they muſt have a Copper which is bigger or leſs, in Proportion to the Size of the Ship, and Number of the Crew: This Copper is fixed in Ships in the Manner as on Land, having under it two Holes divided by an Iron Grate. The firſt Hole, having an Iron Door, is for the Fire; the Aſhes from the Grate drop through into the Bottom of the other; the Smoke paſſes through a Chimney, and is diſcharged as uſual. After the Fire is lighted, it is ſupported by the Air from the Parts next the Aſh-pit; but having, contrary to the uſual Cuſtom, adapted an Iron Door, like the former, made very tight, to prevent the Ingreſs of Air, the Fire would ſoon be extinguiſhed, if not ſupplied by ſome other Aperture; in order to which, one or more Holes are made through the Brickwork in the Side of the Aſh-pit; and Tubes of Lead or Copper, fitted cloſely in the Holes, and made faſt, are laid from thence into the Well, and other Parts of the Ship; by which Means the Air next the Bottom of the Tubes ruſhes through them, and the foul and ſtinking Air ſucceeding, is tranſmitted through the Fire, and paſſes off, without offending, by Means of the Chimney; and a Supply of freſh Air from the other Parts of the Ship continually fills the Place of the former, the Fire requiring a conſtant Support, which Support will be wanting, not only during the Continuance of the Fire, but while any Warmth remains in the Fire-place, Copper, or Brickwork, as was obſerved on board the *Hulk* at *Deptford*, where the Draught of Air through the Tube laſted above 12 Hours after the Fire was taken away. This being conſidered, as the dreſſing the Proviſions for a Number of People will take up ſome Hours every Day, the Warmth of the Brickwork and Flues will continue a Draught of Air from one Day to the next. Mr *Sutton* propoſes thus to circulate the Air by the ſame and no greater Expence of Fire than is cuſtomarily uſed for the Neceſſities of the Ship. The Operation of the Machine will be equally uſeful in large as ſmall Ships; for the greater the Number of People they have on board, the larger Quantity, and longer Continuance, of the Fire will be neceſſary to dreſs the Proviſion; and therefore there will be required a greater Quantity of Air to ſupport that Fire. The Size and Number of the Tubes need not be ſpecified, becauſe as the Conſumption of Air is in Proportion to the Quantity of Fire, the wider the Tube, and greater the Number, the leſs the Velocity of the Air, and *vice verſa*.

I ſeveral Times obſerved in this Machine, when for the Sake of Obſervation, after the Fire was well lighted, and the loweſt Iron Door left open, that the Flame did not aſcend ſo high, or burn ſo fierce; but

immediately upon ſhutting thereof, when the Draught of Air was only through the Tubes, the Flame ſoon recovered it's former Vigour.

There is likewiſe, eſpecially in large Ships, not only a Copper, but alſo a Fire-grate like thoſe uſed in Kitchens: That the Heat and Smoke of this alſo may not be uſeleſs, an Iron Tube may be fixed behind the Grate, and inſerted quite through the Brickwork, and through the Deck, ſo that one End thereof will ſtand about a Foot, or little more, in the Chimney above the Brickwork, and the other will enter into the Hold, or any Part of the Ship; ſo that the upper End being heated, the Draught of Air will be ſupplied from below, as in the other Caſe. This likewiſe was tried on board the *Hulk*, with an Iron Tube about 2 ½ Inches in Diameter, and the lighted Candles held at the Bottom of this Tube were extinguiſhed as faſt as by any of the other.

It may be objected, that a Number of Tubes take up too much Room, eſpecially in Merchants Ships, and are ſubject to be broken or injured by loading or unloading: To remedy which, it is adviſeable, that only one Tube of a convenient Size be made faſt unto the Side of the Aſh-pit, and, as ſoon as it comes through the main Deck, to compreſs it (a circular or any other Form being equally uſeful) not too cloſe; and it may be divided into as many Ramifications as may be thought neceſſary, (eſpecially as the Bread-room, Store-room, *&c.* cannot be kept too ſweet, a Branch for each of theſe) and theſe Branches be carried between the Beams which ſupport the Deck, till they come to the Side of the Ship, and there let down likewiſe between the Beams into the Places intended; by which Contrivance their Operation will not in the leaſt be obſtructed, and the Tubes be ſecured from any Accident.

The Simplicity of this Machine, it being ſo little cumberſome, it's Operation without any Labour to the Seamen, the ſmall Expence to put it in Execution, and maintain it, beſides the before-mentioned Conſiderations, are other Arguments for it's general Uſe.

Stockholm, Nov. 1, 173?.

Concerning an Improvement of the Diving-Bell, by Mr Martin Triewald, *F. R. S. Captain of Mechanics, and Military Architect to his* Swediſh *Majeſty.* No. 444. *p.* 377. Nov. *&c.* 1736.

LXIV. Having the ſole Privilege for diving on all the Coaſts in the *Baltic* belonging to his *Swediſh* Majeſty, no Opportunity has been wanting to make ſufficient Trials with the Diving-Bell and Air-Barrels in ſeveral Depths, according to the ingenious Improvement of Dr *Halley*, made in the Year 1716, but with ſome ſmall Additions.

Experience has likewiſe convinced me, that no Invention built upon any other Principles than thoſe of the *Campana Urinatoria*, can be of Uſe in any conſiderable Depths; or that the Diver, in any other Invention whatever, can be a ſingle Moment ſafe. I will not, for Brevity-ſake, mention the many Impediments that attend other Inventions, only that of a Water-Armour, in which the Man is drowned in an Inſtant, when ſuch a Machine receives the leaſt Leak: Whereas Experience has ſhewn, that when ſuch an Accident has happened to the

Diving-

Diving-Bell, as to my Knowledge it did once, when the Diver was 12 Fathom under Water, and a pretty large Hole happened to be ſtruck in the Bell, by a Boult of the Wreck he went upon, at which Time the Air ruſhed out of the ſame with ſuch Violence as aſtoniſhed the Beholders by the exceſſive boiling on the Surface of the Water, fearing, not without Reaſon, that the Man in the Bell was drowned; but he clapped his Hand to the Hole or Leak, and gave a Sign to be hauled up, which was done with all the Eaſe and Safety as if no Accident had happened to him, the Water having only riſen about ½ a Foot into the Bell by this Leak.

The very ſame Diver that was then in the Bell is 63 Years of Age, and has uſed the Buſineſs of Diving ever ſince he was 20, in a common Diving-Bell, till of late, and is as yet a pretty ſtrong and healthy Man: He declares that never a worſe Accident happened to him in his Buſineſs but once, when the Bell he was in ruſhed down at once about a Fathom or more, by the Careleſſneſs of thoſe that worked the Bell; at which Time the Blood came out of his Noſe and Ears, feeling beſides an intolerable Preſſure on his whole Body; which ſhews, that when a Man in a Diving-Bell is ſlowly and gradually let down, he at ſuch a Time and by Degrees reſpiring compreſſed Air, which by the Lungs is forced into the Blood, cannot feel the external Preſſure, though of highly compreſſed Air, ſurrounding him, and that of the Water reaching ſome Parts of his Body, which Convenience no other Invention can yield or afford, where the Diver is to draw his Breath from Air in it's natural State.

I have often with a great deal of Pleaſure obſerved, that when I have cauſed the Bell to ſtop, being lowered down 5 Fathom, and the Diver taking in the Air contained in an Air-Barrel, lowered down a Fathom deeper than the Bell, without opening the Cock for diſcharging the hot Air; the Water would, by the Acceſs of the Air out of the Barrel, be quite, or to a very ſmall Matter, expelled out of the Bell; and when the ſame was again lowered down 5 Fathom more, the ſame Operation with another Air-Barrel repeated, and the Bell afterwards hauled up, it was no ſmall Matter of Delight to ſee, that every Fathom the Bell came up, it would diſcharge itſelf of the ſuperfluous and large Quantity of Air, which came up from the Bottom of the Bell in very large Bubbles, as big as Eggs of an *Oſtrich*; which Diſcharge of Air and Phænomenon continued, till the Equilibrium of the Air in the Bell, and Preſſure of the Water, was reſtored, and till the Bell came above the Surface of the Water.

At other Times I have obſerved, when no Air was by the Way taken into the Bell, but the ſame lowered down the common Way, and hauled up again after ſome Time, that the very Inſtant when the Bell ſhould part with the Surface of the Water, the Strength of two Men more was required at the Capſton at that Time, than before and after the Bell hung freely in the Air; from whence I preſume it plainly

appears, that the Air which paſſes through the Lungs of a living Creature, loſes it's Elaſticity, and that the Lungs of a Man make a Kind of a Vacuum in the Bell; for which Reaſon the Diver feels at the very Inſtant, when the Bell parts with the Water, a very ſmart Preſſure his in Ears.

Though Experience thus has taught me, that no Invention is more ſafe and uſeful than the *Campana Urinatoria*, with the ingenious Improvements of Dr *Halley*; yet I have likewiſe found, that this Invention is not to be made uſe of without conſiderable Charge, requiring a large Veſſel, and Number of Hands, to the working and managing of ſuch a large Diving-Bell, and the Air-Barrels with their reſpective Weights for ſinking; which Charges, however, according to the Depth of Water, and the Value of what is to be fetched up from the Bottom of the Sea, may not be regarded: But ſince it more frequently happens in theſe Parts, that Cargoes of a far leſs Value than the Loadings of *Spaniſh* Galleons, *&c.* are to be dived for; then next to the Goodneſs of the Invention, I have found myſelf neceſſitated to think how the Expences might be leſſened, and that the Diving-Bell nevertheleſs might anſwer all Intents and Purpoſes of Dr *Halley*'s; which Improvement is as follows:

Fig. 42. The Diving-Bell, A B, I have cauſed to be made of Copper, and reduced the ſame to a very little Compaſs in regard to that of Dr *Halley*'s, as you will ſee by the Scale under the Draught, by which Means it is eaſily managed by two Hands: Yet I preſume that a Diver may not only live in the ſame for as long a Time, and with as much Eaſe, at a very conſiderable Depth of Water, as in a Bell of twice it's Capacity, for this Reaſon, though a Man in a large Bell has undoubtedly more Air than in a leſs, and conſequently ſhould be able to ſubſiſt a great while longer on a large Quantity of Air, than on a ſmall Parcel; yet becauſe his Head for the moſt Part is kept in the upper Part of the Bell, where the hot Air takes up it's Place and Reſidence, he receives very little or no Benefit of the Air under his Chin or Breaſt, though never ſo fit for Reſpiration; which Air nevertheleſs in the lower Parts of the Bell will remain cool a long Time after he has been in the Bell, and with Difficulty drawn his Breath; which cannot be denied, and is very obvious to any body who has been in a *German* Bagnio, and ſuch as are made uſe of in this Country, where in a ſingle Room all the Degrees of Heat are to be felt, by Means of a Contrivance like Stairs to the very Top of the Ceiling, a Man when he places himſelf on the uppermoſt Step will feel an exceſſive Heat, ſo that any body not very much uſed to it cannot endure the ſame, nor draw his Breath, but will faint away; whereas on the firſt, ſecond, and third Steps from the Floor, the Heat is very moderate; nay, ſometimes the Air near the Floor pretty cool, when at the ſame Time near the Ceiling the Heat of the ſame is intolerable. I will not mention many other Inſtances I could produce.

To

To encounter this Inconvenience I have cauſed a ſpiral Tube of Copper, b, c, to be placed cloſe to the Inſide of the Bell, ſo fixed that the ſame may be taken out and cleanſed at Pleaſure, and with Eaſe; and at the ſame Time not to incumber the Diver when he is in the Bell; at the upper End of this Tube b, a flexible Leather Tube is joined 2 Foot long, at the End of which is a turned Ivory Mouth-piece, which the Diver (as ſoon as he perceives the Air to grow hot in the Top of the Bell) keeps conſtantly in his Mouth, which he is able to do by Means of the flexible Tube in whatever Poſture he is in, ſtanding, ſitting, bowing his Head, *&c.* And all the while he draws his Breath through the aforementioned Tube, and the Air from c; by which Contrivance he not only draws continually cool and freſh Air as long as any is in the Bell, but occaſions at the ſame Time a Circulation, which is ſo neceſſary to the very Being of Air, (eſpecially in a compreſſed State) and it's Preſervation for the uſe of Animals, which I have found to be of great Conſequence; and ſo much the more neceſſary, as any body who has been in a Diving-Bell for a long Time, without any new Supplies of Air, and has been reduced to the laſt Extremity of breathing in the ſame, will agree with me, that when at ſuch a Time the Bell begins to be hauled up, and by that Means the compreſſed Air allowed to expand and be put into Motion never ſo little, the Man receives, as it were, a new Life, and incredibible Comfort and Eaſe.

Again, when, in Coal-pits, Levels are driven in the Coal or through Dykes, the Air of the Level or Adits growing hot by the Breath and Sweat of the Hewers and Workmen for want of a Circulation of the Air; I have found it to be an excellent Remedy, to place along the Side of the Drift or Adit, a ſquare wooden Box, open at both Ends, laid from the Place where the Air is cool and good, reaching as far, by joining one Box cloſe to another, as where the Work is carried on. Thus, by this ſimple Contrivance, a Circulation of Air is obtained, and ſometimes to that Degree, that when a Candle is held at the End of the Box where the cool Air enters, the Flame is driven out by the Current of cold Air entring and circulating through the Box.

By which Experiment I am apt to think, that though the Diver ſhould not keep the End of the flexible Tube in his Mouth, which he may do with all the Eaſe in the World, yet that the Air would circulate through the Copper Tube, and he receive no ſmall Benefit by it. D D D D are the Weights for ſinking the Bell, ſo contrived as with great Eaſe to be hooked on the ſame hanging on the Cable. The Iron Plate E, fixed to the Chains F F F, ſerves the Diver to ſtand upon when he is at work.

The Bell is extremely well tinned within all over; and as in all Rivers, and the Coaſts of the *Baltic Sea*, the Water is extremely clear and bright, becauſe of no Ebb and Flood, I have placed three ſtrong convex Lenſes G G G. By theſe Means the Diver cannot only ſee what is under him, but likewiſe on all Sides at a good Diſtance.

Theſe

These Glasses have strong Copper Lids like Snuff-boxes, H H H; which Lids are shut, when there is no Occasion to discover any Objects on the Bottom of the Sea, and serve to preserve the Glasses from being broken.

A Narrative of a new Invention of expanding Fluids, by their being conveyed into certain ignified Vessels, where they are immediately rarefied into an elastic impelling Force, sufficient to give Motion to Hydraulopneumatical and other Engines, for raising Water, and other Uses, &c. by John Payne No. 461. *p.* 821. Aug. *&c.* 1741.

LXV. To produce a great Power at a small Expence, is what every body desires in moving Machinery; and is what, by this new Invention, we have proved by Experiments and Practice to be a great Improvement, when applied to that noble Invention the *Fire-Engine*: Therefore I shall proceed to give a short Description of the Vessels and Machinery contrived for that Purpose, *viz.*

A Pot or Vessel made of wrought or cast Iron, nearly the Figure of a Cone, whose Diameter at the Base is 4 Feet, with Holes round the Edge for Nails or Screws to fasten a globular Head of Copper of about 5 ½ Feet Diameter. There is then placed in the Inside a small Vessel or Machine, which I call a Disperser: This Bason or Vessel hath Spouts round the Sides fixed to it, and the Bottom thereof resteth on a Centre-pin; and in the Middle of this Bason or Vessel is a Socket, with Holes near the Bottom, to let the Water or Fluids pass from above, through an Iron Pipe of about 7 Feet long, the lower End of which is placed in the Socket, so as the End of the Pipe will be always immerged in Water in the Bason, to prevent the expanded Fluids from returning up the Pipe; and the other End of this Pipe goes up through the Copper-head, which is inclosed very tight, but so as it may easily be moved with a circular Motion, in order that the Water or other Fluid, which is conveyed through this Iron Pipe down into the Disperser, may be dispersed or showered round, on the Sides of the red-hot Pan, or ignified Vessel, in a very exact Manner.

Fig. 44.

This evaporating Vessel being thus completed, we then take 1, 2, or more of these Vessels, with these Contingencies, and place it or them in a reverberatory Arch or Canal, for conveying the intense Heat of a strong Fire, the Flame of which encompasses the Metal-Pot or Pots, and brings them to a red Heat; and in that Condition they are continually kept, while in Use, with the Water running from a Cistern or Vessel (where the Water is heated) through a Gauge-cock down the Iron Pipe into the Disperser, which conveys it to the Sides of the ignified Vessel or Pot, when it is immediately rarefied or expanded into an elastic Steam or Vapour, fit for Application to give Motion to sundry Sorts of Machinery, *&c.*

Fig. 43.

A, *A Globe made of Copper,* 12 *Inches Diameter.*
B B, *Two Brass Cocks, one opposite to the other, fitted very tight.*
C, *A Handle or Bale, fastened to the Globe, by which it may be hung or held up.*
D, *A small Valve, or Clack, fitted to the upper Cock, of one Inch Diameter.*

The

The whole thus fitted, weighed 15 Pounds 3 Ounces *Troy*, or 12 Pounds 9 Ounces ½ *Avoirdupois*; and, filled with Water, it weighed 45 Pounds 7 Ounces, from which deduct the Metal, the Weight of Water is 32 Pounds 13 Ounces ½ *Avoirdupois*, which is about 4 Gallons, containing about 925 cubical Inches.

This Veſſel or Globe I then hung over the large Veſſel F, in which Water was rarefied or converted into Steam; and by the Pipe E, at the large Cock G, which being open, as alſo the other Cocks B B, the Steam had a free Paſſage through the Globe A, by which the Steam excluded or forced out the Air that was in the Globe, and by it's elaſtic Quality ſupplied it's Place; when both Cocks B B were ſuddenly ſhut, and the Globe A taken down and hung over a Veſſel of cold Water, with the lower Cock B, immerged in Water, and then opened under Water; on which the Water ruſhed into the Globe very furiouſly, until it had ſupplied the *Vacuum*, when the Cock was again ſhut, and the Globe, with the Water, put in the Scales, and then found to weigh 44 Pounds 9 Ounces; which take from 45 Pounds 7 Ounces, the whole Weight, as before, there remains but 14 Ounces, the Difference, which ſheweth that all the Air was nearly excluded out of the Globe by the Steam: In Ounces it ſtands thus, $\frac{727}{713}$, which is very near a perfect *Vacuum*.

I again excluded the Air out of the Globe with Steam as before, and both Cocks B B being cloſed with the Globe full of Steam, we put the Globe in the Scales, and it weighed 12 Pounds 10 Ounces ½. I then opened one of the Cocks, and let in the Air, on which the Scale deſcended; and, by adding Weight in the other Scale, it was found to weigh 12 Pounds 11 Ounces; which ſhewed that the Weight (not the Preſſure) of the Air the Globe contained, was ½ an Ounce *Avoirdupois*.

The Globe being filled with Steam as before, and condenſed with cold Water on the Outſide of the Globe, and the Metal again made very dry, and the Air let into the Globe, the Water from the condenſed Steam was found to weigh 4 Penny-weight.

The Globe filled with Steam as before, only now I continued the Globe longer with the Steam paſſing through it, by which it acquired a greater Degree of Heat; for I found by thoſe Experiments, that the leaſt Degree of Cold leſs than the Steam, a Part would be condenſed again into Water, by which the Quantity could not be certainly attained to, that would exclude the Air out of a certain Space, which is the chief End of this Experiment. But in this Experiment I ſucceeded better; for, on weighing the Globe, when the Steam was condenſed, the Air let in, and all cold, it was as followeth, *viz.* 15 Pounds 3 Ounces 2 Penny-weights *Troy*, the Weight without the Steam being 15 Pounds 3 Ounces; ſo that the Weight of the Water condenſed from the Steam, or the Water converted into a ſtrong elaſtic Steam to fill the Space of this little Globe, is but 2 Penny-weights, or $\frac{1}{10}$ of an

Ounce

Ounce *Troy* of Water, by which $\frac{1}{10}$ of an Ounce *Troy* of Water fills, when converted into Steam, 925 cubical Inches of Space in a Veſſel, ſo as to exclude nearly all the Air. I repeated this Experiment ſeveral Times, and found it nearly the ſame; and by immerging the Cock in Water, and opening it again, as in the firſt Experiment, I found the Weight of Water to be nearly as above, and to make about $\frac{15}{16}$ Void or *Vacuum*; ſo that 1 Ounce *Troy* of Water makes 9250 Cube-Inches of Steam, of equal Force with the like Number of Inches of Air; and with this Remark, that the Weight of the Steam is much leſs than the Weight of common Air; for in this Globe I found the Air to weigh $\frac{1}{2}$ Ounce *Avoirdupois*, or 9 Penny-weight *Troy*; and the Steam, which filled the ſame Space, to weigh but 2 Penny-weight *Troy*, which is but little more than $\frac{1}{5}$th Part, and ſhews how very ſmall the Particles of Water are when ſo divided by the Force of Fire, and of what Force. From which I ſhall conclude, that 1 cubic Inch of Water will diſcharge or force out 4000 Inches of Air from a Veſſel of that Content, which I have likewiſe proved by other Experiments in working the Fire-Engine: Therefore I ſhall make it my Standard in ſome future Calculations for Practice, about that noble Machine.

I proceeded, as before, with Steam in the Globe A; and condenſed it, as in the third Experiment; and then tried the Preſſure of the Atmoſphere on the Clack or Valve D, and found it required about 10 ℔ *Troy*, to lift the Clack from it's Tube of 1 Inch Diameter; but in this I was not exact with ſmall Weights.

I excluded the Air with the Steam, and in Place of the Clack I ſcrewed on very tight a Plate, on which I placed a Glaſs Receiver, as uſual, with the Air-Pump; and then, turning the Cock, the Air under the Glaſs Receiver expanded itſelf into the Globe, by which I had equally a Share of the *Vacuum* partly made in the Globe, and could thereby make many Experiments that are made with the Air-Pump, *&c.* which I mention only, that ſome curious Gentlemen may hereafter make ſome further Obſervations by the like Experiments.

Obſervations from Experiments made by J. Payne.

1. That a Pot or Veſſel, of the Size and Shape here mentioned, will (being kept to a dark-red Heat, and the Water regularly diſperſed) rarefy or expand 50 Gallons of Water, Wine-Meaſure, *per* Hour.

2. That a Cube Inch of Water will make in Practice 4000 Inches of Steam; or that the elaſtic Steam of one Cube-Inch of Water is ſufficient to exclude the Air out of a Veſſel that is in Content 4000 Inches.

3. That the above 50 Gallons will produce 46,000,000 Cube-Inches of elaſtic Steam *per* Hour, which is *per* Minute 770,000.

4. That the ſecond Pot or Veſſel, as in the Draught TAB. VI. *Fig.* 2, will rarefy or expand 40 Gallons of Water, Wine-Maſure, *per* Hour, and will produce 36,960,000 Cube-Inches of elaſtic Steam *per* Hour, which is *per* Minute 616,000 Inches.

5. That

5. That both being united together make 1,386,000 Cube-Inches of Steam every Minute, from 346 Inches of Water.

6. That, by an Experiment made at a Fire-Engine, 40 Gallons of Water *per* Hour, made into elaſtic Steam in this Method, will effectually give Motion to a 24 Inch Cylinder *Fire-Engine.*

7. That, by true Experiments made at *Wedgbury* and *Newcaſtle on Tyne*, one hundred Weight, containing 112 ℔ of Pit-coals, will and is ſufficient in this Method to expand or rarefy 90 Gallons of Water *per* Hour into an elaſtic Steam or Vapour.

8. That, by the beſt Accounts and Obſervations I could get and make, they conſume under their Boilers to make the ſame Quantity of Steam, 300 Weight of Pit-coal, at 112 ℔ to the 100, in working a Fire-Engine one Hour.

9. That 95 Gallons of Water *per* Hour, expanded or rarefied into Steam, will work a 36 Inch Cylinder Engine.

10. From theſe Obſervations I conclude, that this new Invention will ſave at leaſt 60 *per Cent.* in Pit-coals to work a Fire-Engine.

Fig. 43.

A, A, *The two Pots.*
B, B, *The two Copper Heads or Globes.*
C, C, *The two ſinking Pipes, for waſte Water, that is not evaporated.*
D, D, *Clacks or Valves to keep out the Air.*
E, E, *The two Diſperſers and Spouts.*
F, F, *The Stools with a Centre-pin, on which the Diſperſer reſteth.*
G, G, *The two Iron Pipes, in which the Water is conveyed to the Ciſtern.*
H, *A Ciſtern of hot Water.*
I, I, *Two Cog-wheels to turn the Diſperſer.*
K, *A Steam-pipe, in which is conveyed the Steam to the Cylinder.*
L, *The Cylinder of the Fire-Engine.*
M, M, *Leaden Pipes that convey hot Water from the Ciſtern in the Diſperſer.*

CHAP. II.

HYDROLOGY.

I. *MALHOLM* is a pretty Country Village, ſituated on the Southern Side of a monſtrous high Hill, the Aſcent of which is not very ſteep. By a Break between this Hill and another, which are joined by a Rock, which meaſures 82 Yards perpendicular, and ſeems to be about $\frac{2}{3}$ of the Height of the Hill, I conclude the Hill to be about 120 Yards perpendicular. On the Top of this Rock there ſtill remains

A Deſcription of a large Lake called Malholm Tarn, *near* Skipton *in* Craven, *in the County of* York, *by*

John Fuller, *Eſq; jun. F. R. S.* No. 459. *p.* 612. Jan. *&c.* 1741.

remains the Appearance of a Channel for 2 or 300 Yards together, which, by it's having no Mould or Earth to cover it, I judge to have been a Paſſage for that Water, which formerly uſed to tumble over the Precipice, but now has found a Paſſage under-ground, and flows out at the Bottom of the Rock, being now called *Air-Head*, *viz.* the Head of the River *Air*. The Rock is called *Malholm Cove*.

Between the Top of this Mountain and the Tops of four others, is *Malholm Tarn* *. (I ſay the Tops of them, for though they ſteep a Quarter of a Mile towards the Lake from their Tops, it is at a Mile and an half down to the flat Country on the Outſide.) This Lake is between 3 or 400 Acres. The Shape of it is a Parallelogram, the Length of which equals about twice the Breadth: There are no Weeds in it. In a fine ſtill Day, you may ſee the white chalky Bottom, where it is 10 or 12 Foot deep. I wonder *Camden* takes no Notice of this Lake, for it muſt have been there in his Time, and he muſt have been very near it; for he deſcribes a Precipice, which I am pretty certain is the Northern Side of one of thoſe very Hills which help to form *Malholm Tarn*. There are but 2 viſible Springs that ſupply it with Water, one lies E. the other N W; and by what I could gueſs, there are only theſe 2 Springs; for the Diſcharge ſeems to be no greater than what theſe Springs ſupply.

The ſuperfluous Water of this Lake is diſcharged by a gliding Stream, about 4 Feet broad, and 2 or 3 Inches deep; which runs above-ground about 2 or 300 Yards, and then dips under-ground at two different Places about 10 Yards diſtant from one another. What becomes of theſe Streams after their dipping, (though the Relation appears ſomewhat fabulous, yet) as it is affirmed by all the Men of Credit in the Neighbourhood, I could not help believing it. About a Mile below *Malholm* Village there are 2 Springs that diſcharge themſelves into the River *Air* about 10 Yards diſtant from one another, one ſomewhat greater than the other. The Neighbours aſſured me, that if Wheat-chaff was put into either of the Rivulets at the Place of their dipping, in about 8 Hours Time it would come out at the greater or leſſer Spring, and not out of both, into the River *Air*, which is from the Place of their firſt dipping about 2 ½ Miles. By this it appears, that theſe 2 Rivulets never communicate in their ſubterraneous Paſſage.

The *Tarn* abounds with only 2 Sorts of Fiſh, *Trouts* and *Perch*: The *Trouts* very large and red; the *Perch* far exceed in Size and Goodneſs any I have ever ſeen, being commonly 20 Inches long, weighing 4 or 5 Pounds. They are taken only with Hooks, it being ſo deep and ſtony, that you cannot draw a Net: The only Bait for them is an Earth-worm; the rocky Soil, and the Springs coming ſo little a Way, affording them very little of that Sort of Food.

A High Tide in the River Thames, *on*

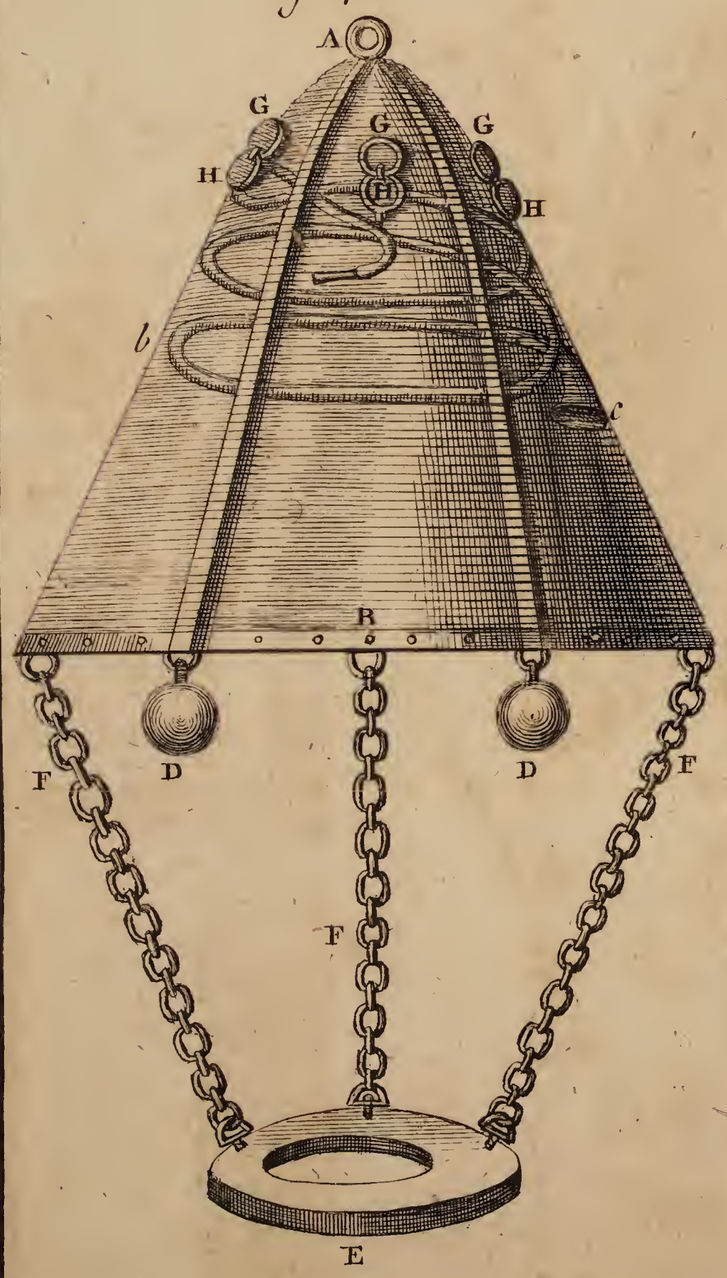
II. *Mar.* 8, 172⅙, the Tide flowed 20 Foot 5 ½ Inches, as I took it by a Level from that High Water Mark to Low Water the next Morn-

* A *Saxon* Word for a Lake.

ing,

Fig. 41.

Fig. 42.



A Scale of 4 Engliſh feet for Figure 42.

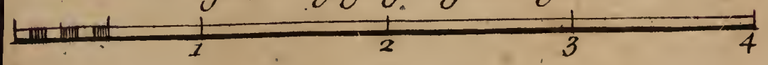


Fig. 44.

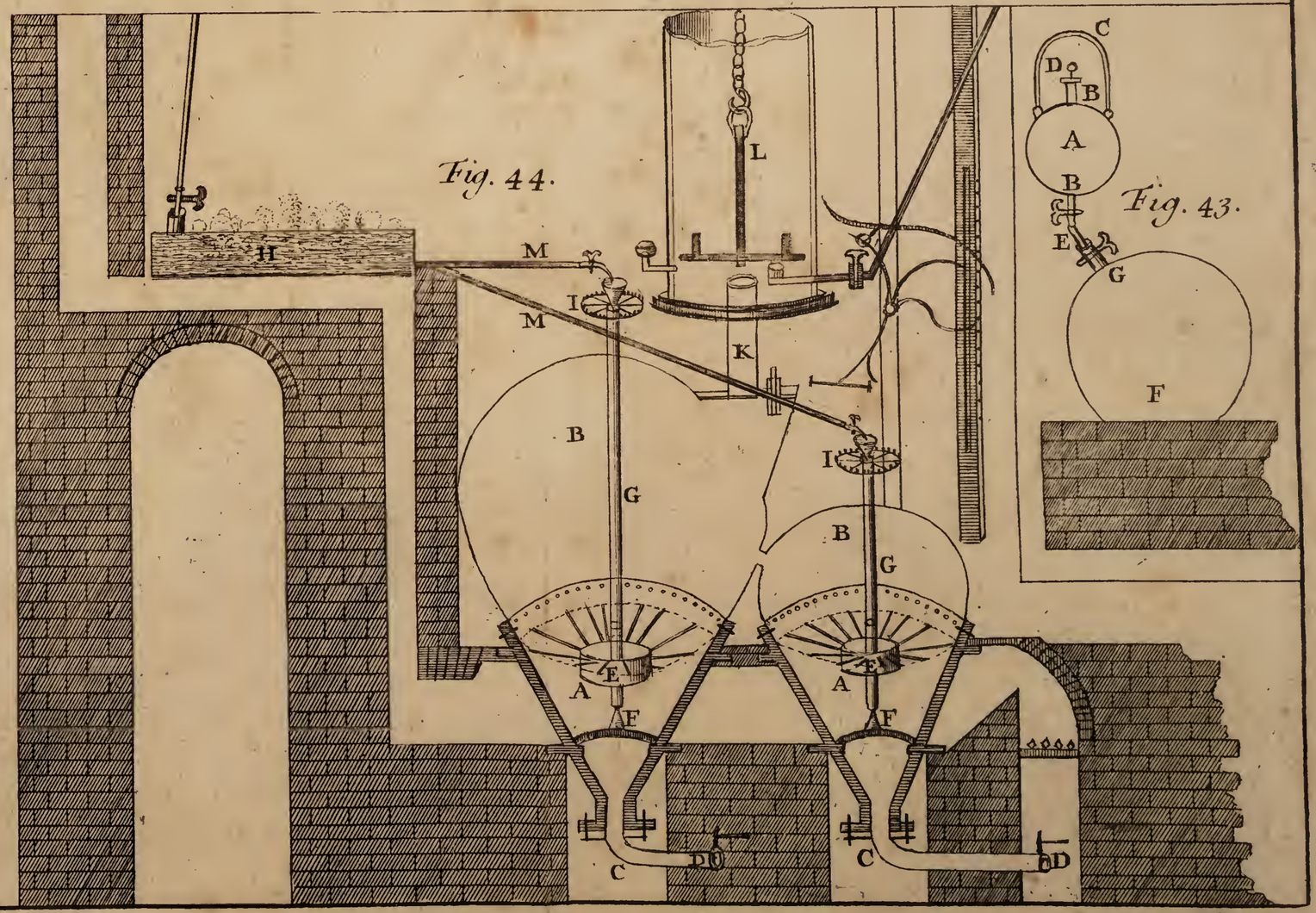


Fig. 43.

ing, and was 4 Inches higher than had been known for 40 Years before.

Feb. 16, 1735-6, *by* Mr Thomas Jones. No. 440. *p.* 198. Jan. *&c.* 1736.

But on *Feb.* 16, 173$\frac{5}{6}$, the Tide roſe at the ſame Place 6 $\frac{3}{4}$ Inches above that Mark, and flowed near 2 Foot the laſt half Hour but one before High Water.

New Crane, Feb. 17, 1735-6.

N. B. If the Tide had flowed it's full Time, it would have flowed half an Hour longer, and had drowned the whole Level.

III. Dr *Hales*, in his learned Paper lately read at the *Royal Society*, wherein he propoſes a Method of rendering Sea-Water freſh, and wholſome to drink, mentions a Diverſity of Saltneſs of the Water at the *Nore* in the Mouth of the *Thames*, and the Water taken up in the *Mediterranean Sea*, this containing $\frac{1}{27}$ of Salt, the former $\frac{1}{29}$. Mr *Boyle*, in his Obſervations of the Saltneſs of the Sea, *p.* 4, ſaith, that about *Holland* the Salt in the Sea-Water hath been found to be $\frac{1}{45}$. In the *Engliſh* Channel, *p.* 31, he found Sea-Water $\frac{1}{45}$ heavier than Conduit-Water; and, by immerſing a Lump of Sulphur in it, he found the Difference $\frac{1}{53}$; but by Diſtillation *ad ſiccitatem*, *p.* 33, he found the Salt to be $\frac{1}{30}$, and in another Trial $\frac{1}{37}$. It is certain the Sea differs in Saltneſs in different Parts: It is in general obſerved, that in hotteſt Climates the Water is the ſalteſt. At *Moſambique* Mr *Boyle*, *ib. p.* 29, relates an Inſtance of a Ship drawing two Hands-breadth leſs Water than uſual. On the contrary, when Salt-Water freezes, it hath been thought to let fall all it's Salt; the Ice of Sea-Water, and the Water melted from it, taſting freſh, and being good for boiling Meat and Peaſe in: Capt. *Middleton*, being in *Hudſon's Streights* in *July* 1738, took Ice from under the Surface of the Sea, which he melted till he got 40 Quarts of Water, which he evaporated to Dryneſs, and out of that Quantity had only ſix Ounces of Salt, or about $\frac{1}{213}$.

An Examination of Sea-Water frozen and melted again, to try what Quantity of Salt is contained in ſuch Ice, made in Hudſon's Streights *by Capt.* Chriſtopher Middleton, *F. R. S. at the Requeſt of* C. Mortimer, *R. S. Secr.* No. 461. *p.* 806. Aug. *&c.* 1741.

IV. Exp. 1. Upon ſteeping or infuſing ſome Scrapings of Gall in it, (after ſtanding a long Time) it turned of a bright Purple Colour.

Exp. 2. Upon the Inſtillation of *Ol. Tartari per Deliq.* it immediately became troubled or muddy, and ſeemed as if Goblets of Fat were fluctuating in it. This unctuous Matter, upon long ſtanding in Repoſe, came gradually into cloſer Contact, and at laſt ſubſided.

Exp. 3. Upon the Inſtillation of *Spirit* of *Vitriol*, it depoſited a Milk-white greaſy Sediment; which, after 12 Hours Repoſe, occupied $\frac{1}{5}$ Part of the Vehicle or Liquor.

Exp. 4. Being mixed with a Solution of *Saccharum Saturni*, it let fall a ſmall Quantity of a greyiſh Powder.

Exp. 5. Being ſeverally and ſeparately mixed with Solution of Sublimate, with *Sp. Sal. Armoniac.* and with Sugar of Violets; it neither fermented, depoſited any Sediment, grew turbid, nor changed Colour; except only from the Sugar of Violets, which turned it of a dark Green.

Experiments, by Way of Analyſis, upon the Water of the Dead Sea; *upon the hot Spring near* Tiberiades; *and upon the* Hammam Pharoan *Water; by* Charles Perry, *M. D. made on his Journey thro' the Holy Land*, &c No. 462. *p.* 48. *Read* Feb. 25. 1741-2.

Obſervations. This Water is highly ſaturated with Salt, inſomuch that any Meaſure of it preponderates freſh Water under equal Surfaces, in the *Ratio* of 5 to 4.

It has alſo a wonderful Acrity, inſomuch that being held in the Mouth for a ſhort Time, it conſtringes it in like Manner as Alum does.

I cannot (from the above *Experiments*, and the Appearances which reſulted from them) conclude, that this Water is impregnated with any Thing more than mere Salt, which is of a very acrid, alkaline Nature; and ſomething elſe, which may be of a compound Nature, partly ſulphureous, and partly bituminous. But, to ſpeak negatively, it may be preſumed, I think, that it neither partakes of Steel, Alum, nor Vitriol, nor yet of a pure, genuine Sulphur: And, conſequently, as I take it, can afford no other, nor better Effects, to ſuch as may bathe in it, than other Sea-Water; except only, that it's greater Degree of Salt, and ſuperior Weight, may ſomewhat heighten the ſame Effects.

Experiments (by Way of Analyſis) upon the hot Spring-Water near Tiberiades.

Exp. 1. *Oil* of *Tartar. per Deliq.* ℥ſs, being mixed with ℥iſs of the Water, it became troubled and muddy; and after ſtanding 12 Hours in Repoſe, ¾ of the whole, from the Bottom upwards, appeared like white Wool: But this woolly Water, being ſeparated by Filtration, and left to dry, ſeemed no other than a yellowiſh Oker.

Exp. 2. I mixed ℥ſs *Sp. Vitriol* with ℥iſs of the Water, and, after 12 Hours ſtanding ſtill, I found a large Sediment of a white unctuous Matter.

Exp. 3. Solution of *Sublimate* ℥ſs being mixed ℥iſs of the Water, it became turbid and yellowiſh, and yielded an earthy Sediment in ſmall Quantity; whence I conclude it contains a *Sal murale*.

Exp. 4. One Ounce and half of the Water, mixed with ℥ſs of a Solution of *Sacch. Saturni*, depoſited a greyiſh Sediment of a lateritious Matter, in ſmall Quantity.

Exp. 5. One Ounce and half of the Water, mixed with ℥ſs *Sp. Sal. Armoniac*, turned turbid, of a Colour betwixt Green and Blue; and after 12 Hours Repoſe, yielded a woolly Sediment of four Digits deep.

Exp. 6. One Ounce and half of the Water, mixed with ℥ſs *Sacch. Violar.* became troubled, and of a dark-yellowiſh Colour.

Exp. 7. One Ounce and half mixed with ℥ſs of Scrapings of Gall, became of a fine Violet Colour; but when ſhook, was as deep as Ink.

Obſervations. This Water (as appears to my Judgment) contains a good deal of a groſs fixed Vitriol, ſome Alum, and a mural Salt of a limy Quality.

'Tis too ſalt and nauſeous for internal Uſe; but by bathing in it, muſt be good for all cutaneous Diſtempers, and eſpecially for the Scurvy and Leproſy: For it will powerfully deterge, ſcour, and clean the excretory Pores; and it may, by it's Weight and *Stimulus*, reſtore them to their natural State, Strength, and Elaſticity. It may, by the ſame Means, reſtore the loſt or impaired Tone of the Solids in general: In Conſequence of which it may thin the Blood, help it's Circulation, and promote

promote the natural Digeſtions and Secretions; and thus, finally, it may be uſeful in Rheumatiſms, Dropſies, Jaundices, and nephritic Diſeaſes.

Analyſis of the Hammam Pharoan *Water, near* Corromondel, *on the Way to* Mount Sinai.

Exp. 1. This Water being mixed with the Scrapings of Gall, manifeſted no ſenſible Change at firſt; but after long ſtanding it grew ſomewhat greeniſh.

Exp. 2. Upon the Inſtillation of *Sp. Sal. Armoniac.* it became turbid; and on ſtanding ſome Time in Repoſe, depoſited a dark-greyiſh Powder, in ſmall Quantity.

Exp. 3. Four Ounces of the Water, being mixed with ℥iſs *Sacch. Violar.* manifeſted no Change, except what would neceſſarily reſult from the Tincture of Violets.

Exp. 4. Being mixed with a Solution of *Sacch. Saturni*, it became immediately very turbid; but on ſtanding ſome Time in Repoſe, it depoſited a large dark-brown Sediment, leaving the Vehicle troubled and whitiſh.

Exp. 5. I mixed a Solution of *Sublimate* with it, upon which it became immediately yellow; but, after ſtanding at Reſt, it depoſited a woolly unctuous Matter, in ſmall Quantity.

Exp. 6. Being mixed with *Ol. Tartari per Deliq.* it became of a chyly Colour and Subſtance, or of a turbid pearly Colour.

Exp. 7. Being mixed with *Spirit of Vitriol*, it manifeſted no Change, either of Colour or Tranſparency.

Obſervation. I conclude from the *Phænomena* which appeared upon Analyſation, that this Water is impregnated with a good deal of a groſs earthy Sulphur, a neutral Salt, a ſmall Quantity of Alum, but no Proportion of Vitriol.

This cannot be uſed inwardly, it being nauſeous beyond Expreſſion: It ſmells ſomewhat like rotten Eggs, but much worſe. But, uſed by Way of Bath, it may cleanſe the Skin of all Foulneſſes, purge and deterge the cutaneous Glands from all foul noxious Humours: It may reinforce the natural Heat and Vigour, (where they are decayed) and may reſtore the impaired Digeſtion: And hence, finally, it may promote Virility in Men, and Fecundity in Women. It may likewiſe be uſeful in the Gout; as alſo in Epilepſies, and other Diſeaſes of the nervous Claſs.

Of the Cement-Waſſer *Waters in* Hungary, *by* Matthias Belius, *F R. S. and Collegue of the R. S. of Sciences at* Berlin. No. 450. *p.* 351. Oct. *&c.* 1738.

V. The *Newhauſel*, commonly called *Cement-Waſſer*, Waters are well known by the Learned. *Kircher* in his *Mundus ſubterraneus* *, Dr *Edward Brown*, in his Travels †, and *Jacobus Tollius*, in his *Epiſtolae Itinerariae* ‖, have mentioned them, not to ſpeak of other leſs conſiderable Writers.

They riſe a Mile from *Newhauſel*, in that vaſt Copper-Mine, which is known by the Name of *Herrn Grund.* We have no Knowledge of the Diſcovery of them, but from the Traditions of the Vulgar. That they

* Tom. II. *p.* 185. † *P.* 186. ‖ *P.* 191.

were

were not famous in the time of *George Agricola*, we may infer from his Silence. It is ſaid however, that they were accidentally found in 1605; when *Newhauſel* was plundered and burnt. The Miners, in that Confuſion, concealed their Inſtruments in the Mines, where they lay in moiſt Places above a Month, and were found incruſted with Copper, when taken out; and the more ſo, in Proportion as they lay deeper. This induced them to make Channels to receive theſe *ærific* Waters, and afterwards to incloſe them.

They ſoon diſcovered, that Iron being thrown in was conſumed, and turned to an equal Quantity of the pureſt Copper. This way of procuring Copper was found to be ſo compendious, that they have made 20 of theſe Incloſures. We ſhall take notice only of two of theſe, from which we may form a Judgment of the reſt. The chief of theſe is ſunk 85 *Orgyiæ*, and the Acceſs to it is by a winding of 151 *Orgyiæ* Here the Water diſtils from the Sides of the Mine, and is received at firſt in a ſmall Baſon, from whence it flows into a larger, and is divided into Channels. In the ſmaller Baſon they put little Pieces of Iron, ſuch as Horſe-ſhoes; and in 3 or 4 Weeks time, find them turned to Copper, retaining their former ſhape, but being a little more elevated. This Water is more efficacious, than that which is received in the larger Baſon. It corrodes the Iron more languidly; for at firſt there floats upon the Water only a yellowiſh Scum, which afterwards ſticks to the Iron, and is ſcraped off every Month with great Exactneſs, and laid in a particular Chamber to drain. This Scum is called *Schmund* by the Miners. They repeat this Operation, till all, or the greateſt Part of the Iron is conſumed.

The other Chamber is 15 *Orgyiæ* deeper; and from it's Form and Situation is called the *Long* one, being 2 *Orgyiæ* in Breadth, and 25 in Length. The Copper-water drops here in greater plenty than in the other Incloſures or Chambers. For beſides the dropping from the Sides and Cavities of the Mine, there are two perpetual Springs, which continually iſſue to the Thickneſs of a Straw. Both theſe Springs open on the South, one of them 3 Paces on the Left-hand from the Entrance of the Chamber, the other 5 Paces more inward. To keep the Waters from being waſted, they are brought through little Ducts, partly into Channels, and partly into ſquare Baſons, where they throw their Iron. We obſerved, that the Channels made for the Reception of the Water and Iron, are ſo carefully diſpoſed on the Ground, that none of the dropping Water can be loſt. What is received after that manner in one Channel, runs over into another, that into a third, and ſo on; but the Efficacy of the Water is diminiſhed in every Channel. In the middle of the Wall of this Chamber there drops a peculiar limpid Water; which is therefore collected in a particular Baſon. Into this they throw the Copper made in the other Chambers, when they deſire to have it more pure. As the Chambers are ſteep, the Waters that flow from the Channels and Baſons, are quite abſorbed by the porous Bottom of the Mine.

Mine. Beſides theſe Receptacles, there are in the Caverns of the Mine many moiſt Places, which give a copper Colour to Iron; which ſhews that moſt of the humours of the Mine are of that Nature.

The Water looks greeniſh in the Baſons; but in a clear Glaſs it is as tranſparent as Cryſtal. It has no Smell, but has an aſtringent vitriolic Taſte. On our taſting it at the Spring, it bliſtered our Lips. Whilſt we were in the Mine, and travelled 3 or 4 *German* Miles thro' ſubterraneous Windings, we felt no other diſorder in our Lips than a ſlight itching; but as ſoon as we came into the open Air, they began firſt to ſwell, and then to form Matter. When the Water drops in larger Quantities it grows weaker, and has a leſs ſenſible Effect upon Iron. It is ſo far from rotting the wooden Troughs and Baſons, which receive it, that it conſolidates them, and makes them laſt longer than they otherwiſe would. The Chambers, in which the Baſons are incloſed, have not any ſtrong Smell, or any Vitriol in them. But in ſome of the Chambers, one may find here and there a little Stone reſembling blue Vitriol. At the Sides of ſome of the Caverns, we found a ſort of Salt, mixt with a moiſt, yellow Earth, inſipid, and friable like the *Lapis Specularis*. The Miners, a people ſubject to Diſeaſes, drink this Water, as a medicated Potion, in deſperate Diſorders, with great Confidence of Succeſs. It ſoon works either upwards or downwards, or both ways. In an *Ophthalmia*, the uſe of it is ſafer, if it is applied with Caution after the manner of a *Collyrium*.

The Copper obtained from theſe Waters is more pure, more ductile, and more fuſible, than any other ſorts of that Metal; which makes it be ſought after in the making of Snuff-Boxes, and other ſuch like Utenſils. Whilſt this Copper is yet in the Water, it is more friable, than after it is taken out: For then the Particles are more ſtrongly concreted, and grow ſolid. The Scum beforementioned is only indigeſted Copper precipitated from the Water, and adhering to the Iron. It is carried every Year to the Copper-work at *Newhauſel*, and is there melted into the pureſt Copper; and that without much Loſs; becauſe the Iron being corroded by the Copper-water, leaves but very little heterogeneous Matter in the Scum. Before theſe Springs were injured by a Inundation, which happened in our Time; a much greater Quantity of Copper was produced from Iron. For it is certain, that in 1707, 88 hundred weight of Iron was turned to Copper, whereas now they hardly get 20 hundred Weight in a Year. Hence we may conclude, that this Inundation greatly diminiſhed the Efficacy of the Water: For fewer Chambers formerly produced more Copper, than is now made in 20. Indeed many of them now do not produce any ſolid Copper, but only the Scum already mentioned, which muſt at laſt be melted down with a ſtrong Fire.

I ſhall now relate the Experiments made by me and my Friends, in order to diſcover more perfectly the Nature of theſe Waters.

A Pound

A Pound of the ſtrongeſt and moſt pregnant Copper-Water gradually and gently evaporated, grew turbid and let fall ſomething of a yellow Powder; and being afterwards boiled to Dryneſs, left ℈ijſs of a greeniſh *Reſiduum*. This *Reſiduum* being afterwards diſſolved in Water, afforded a green Solution; which being filtered and evaporated, yeilded ℈ij of a cryſtalliform Vitriol. What remained of the Powder was yellow, and Gr. vj in Weight.

A Pound of the ſame Water, precipitated with Oil of Tartar, grew turbid, and became of a Sea-green Colour. It left a Reſidue in the Filtre, which being dried, afforded ℈ijſs, with a little common Salt.

A Pound of the Water in a Bottle cloſe ſhut, began ſenſibly to tinge a ſmall Wedge of Iron, that was put into it, of a Copper Colour, having ſeveral Bubbles adhering to it. The next Day the Water grew turbid and whitiſh, having ſeveral whitiſh Streaks at the Bottom of the Bottle, and about the Wedge; and after ſome Days we found a yellow or Copper-like Sediment.

From theſe Experiments we learn,

1. That this is a true Copper-Water, and ſaturated with Vitriol of Copper, and that it flows from a Solution of *Pyritæ* in the metallic Veins; and hence that it may be called a *vitriolated Water*.

2. That this Water corrodes and diſſolves Iron, and precipitates the Particles of Copper exiſting in it, as in a *Menſtruum*; or lets them fall to the Bottom, after being ſeparated by this Diſſolvent; aſſuming the Form of the injected Iron, to which they adhere. This is abundantly confirmed by a nice Inſpection of this Copper: For it is formed into a ſolid and ſmooth Maſs, but infinite little Grains, like the Eggs of Fiſhes, uniting, it coaleſces into one friable and extremely brittle Body. It is a Thing well known to all Chymiſts and Workers in Metals, that one Metal is precipitated by another. Thus Quickſilver diſſolved in *Aqua fortis* precipitates Silver; Silver precipitates Lead; Lead Copper; and Copper Iron. Hence if you diſſolve Copper in *Aqua fortis*, and then put Lead into it, you may obſerve the ſame Tranſmutation, as we have now obſerved in our Copper-Water: For that *Menſtruum* will corrode and diſſolve Iron; and in that Action, the Copper being mixed with the *Menſtruum*, will be ſeparated from it, and gradually and gently ſubſide into the Place of Iron.

Theſe Rules being eſtabliſhed, the Notions which ſome have too haſtily admitted, on conſidering the Effects of theſe Waters may eaſily be refuted.

1. There being taken out of this Water a Quantity of Copper equal to the Iron put in, it is falſly inferred, that the Iron being corroded by the Water, lets fall the Particles of Copper which it contained, as freed from a Bond, and entirely conſumes the other material Particles, and makes them vaniſh.

2. Nor can the eſſential Tranſmutation of Iron into Copper be admitted in all this Work of Nature: Which the Alchymiſts perſuade themſelves

themſelves and others to believe; as if a more ignoble and imperfect Metal could have it's whole Subſtance changed into another more perfect and noble. For it ſufficiently appears from theſe Experiments, and is evident from phyſical Reaſoning, that our Water by no Means changes Iron into Copper, but only depoſits the Particles of Copper, with which it was before impregnated. Nay the contrary might be proved from our Obſervations. For if Iron and Copper, the moſt nearly related Metals, cannot be changed into each other by the Aſſiſtance of Nature; much leſs can it be expected from Art, how ſkilful ſoever. Now that Iron and Copper are more related than any other Metals, is made more than probable by *Henckelius* in his *Kieſs Hiſtorie*, or *Hiſtory of Pyritæ*, where he affirms, that among ſo many Experiments, he never met with any one Piece of Copper Ore, that was not affected by the Magnet. Thus this attractive Virtue of the Magnet operates upon Copper next to Iron. And as Iron and Copper both afford what is properly called Vitriol, which cannot be ſaid of the reſt, in the ſame Form; for they are of the like Subſtance and Colour, green or blue; if there was any ſuch Thing as the pretended Hermaphrodite Vitriol, it would certainly be diſcovered in this Workmanſhip of Nature, which it is not.

That this Water of *Newhauſel*, as was ſaid before, derives all it's Power and Efficacy from a diſſolved *Pyrites* of Copper, is proved alſo from the Works at *Schmolnicz*: For the whole metallic Country about that Town is full of Copper *Pyritæ*; ſo that the Copper-Water abounds not only in the Mines, but on the very Surface; ſo that it is more pregnant and efficacious than this of ours. In dry Weather the People of *Schmolnicz* pour common Water upon Heaps of *Pyritæ*, which being received in Troughs and Baſons, acquires the ſame Power and Efficacy as the natural Copper-Waters.

VI. Obſ. 1. I took ℥iv of the *Weſtaſhton* Water, with as much Milk, and ſet them on the Fire; as ſoon as they boiled, the Milk began to curdle, which denotes a brackiſh Salt of a neuter Nature. The Water changes Syrup of Violets green.

Obſ. 2. Some Powder of Galls infuſed in this Water, gives it a Tinge of a brown Purple, by which it appears, that this Water is Chalybeat: For all martial Waters will, with Galls, turn blackiſh or inky.

Obſ. 3. A fixt *Alcali*, as *Ol. Tartar. per deliq.* and a volatile one, as *Sp. Sal. Armoniaci*, cauſed a white Precipitation, which denotes an aluminous cretaceous Earth.

Obſ. 4. A Solution of Salt of Lead, cauſes a Cream-like, or a troubled milky Colour.

Obſ. 5. The uſual acid Spirits, *viz.* Spirit of Salt, Nitre, and Vitriol, cauſe no Alteration; which ſhews that the Water is itſelf impregnated with an Acid.

Obſ. 6. The Water being evaporated to a Pellicule, depoſits ſaline Cryſtals of a rough or auſtere Taſte, being of a ſtyptic Nature; and ſeparates a martial yellowiſh Okre (which is attracted by the Loadſtone)

An Examination of Weſtaſhton *Well-Waters, belonging to* Tho. Beach, *Eſq; a Well about* 4 *Miles from that of* Holt, *by* Ambroſe Godfrey Hanckewitz. No. 461. *p.* 828. Aug. *&c.* 1741.

and is an Abſorbent, for it ferments with Acids. The remaining Brine, being evaporated to Dryneſs, leaves a Salt of a lixivious alcaline Taſte.

Obſ. 7. Some of theſe Salts being put into Water, 3 Parts out of 4 diſſolve very readily; but ¼ Part will not diſſolve at all, but is of a talcky Nature, and unalterable in the Fire.

Hence we may obſerve, that chalybeat Waters, as long as they retain their natural ſulphureous *Gas* are capable of keeping ſuſpended, or floating in them, theſe talcky Subſtances; but that Boiling drives away that ſulphureous *Gas*, upon which this talcky Subſtance ſubſides, and cannot again be diſſolved in Water, and remains fixt againſt the Power of the Fire; for it ſuffers no Alteration upon a red-hot Iron, neither emitting Flame, nor melting, as neither doth Talck itſelf.

Obſ. 8. Theſe chalybeat Waters contain ſomewhat of the ſame Nature as our cathartic *Epſom-Salt*, only not ſo mild upon the Tongue; for by this Examen, when their *Gas* is gone, they are found to contain two Sorts of ſuch-like Earths; the one abſorbent, fermenting with Acids; and the other fixt, or talcky: And that this Subſtance is really talcky, is confirmed by the digging up of a pretty deal of Talck in the ſinking this Well.

All the Salts of the medical Waters are more generally alcaline than acid, being of a martial Nature, impregnated with Sulphur, which gives them a muriatic Taſte.

We may hence conclude, that this *Weſtaſhton* Water is a very good chalybeat Water; and, by Report, more plentiful and more conſtant all the Year round, than the Well at *Holt*, which Spring diminiſhes much at a certain Time of the Year; but both ſeem alike for their Virtues, and phyſical Uſe, being both alike martial.

An Examination of the Chiltenham *mineral Water, by* Conradus-Hieronymus Senckenberg; *which may ſerve as a Method in general for examining mineral Waters.* Ibid. *p.* 830.

VII. 1. The Water is bright and clear to the Sight, of no Smell, yet of a bitter Taſte.

To know it's conſtituent Parts, the following Experiments were made; and, firſt, to try whether there is any *alcaline Salt* in it.

Rheniſh Wine was mixt with the mineral Water. *Rheniſh Wine* is a ſubtilized *Acidum eſſentiale* in a ſpirituous and oily Liquor: Wherefore an *alcaline Salt* ſhould have been manifeſted; but it was unaltered.

Diſtilled Vinegar is a ſtronger vegetable Acid; but, mixed with the Water, procures no Alteration.

Spiritus Salis, *Nitri*, and *Vitrioli*, the three ſtrongeſt and pureſt mineral Acids, being mixed with the mineral Water, there was no Change or Precipitation.

Mercurius ſublimatus-corroſivus, is a Diſſolution of Quickſilver in concentred Spirit of Salt, which, being diſſolved in common diſtilled Water, manifeſted not only the volatile, but alſo the fixed alcaline Salt, in any Liquor, inſomuch that it precipitates the *Volatiles* to a *white*, and the *fixed* alcaline Salts to a *red* Powder; but, mixed with this Water, produced no Precipitation.

Vitriolum

Vitriolum Martis is an acid Salt, intimately mixed with Iron-Earth: Being diſſolved, and put into another Liquor, it will preſently betray the alcaline Salts by precipitating them; but ſhould it find no contrary Salt, then ſomewhat of the Iron-Earth will ſettle to the Bottom; as is common in diſſolving all Sorts of *Copperas:* And ſo it happened by mixing this mineral Water with it, when a brown Powder ſettled, which is the *Terra Martialis.*

All theſe Experiments ſhew evidently, that no *alcaline Salt* is in the ſaid mineral Water.

For, to try whether there is any acid Salt to be found in this Water, the following Mixtures were made:

Aqua Calcis Vivæ, which contains an Earth impregnated with *alcaline Salt*, makes a very quick Diſcovery of an *Acid*, by Precipitation; but, mixed with this Water, cauſed no Variation.

Syrupus Violarum, having a very ſenſible vegetable Tincture, which, by mixing it with a ſmall Quantity of any *Acid*, turns *red*, and, with an *alcaline* Salt, *green*; but, mixed with this Water, keeps it's Colour.

Oleum Tartari per deliquium, which is an *alcaline* Salt, diſſolved in Water: And,

Spiritus Salis Armoniaci, a volatile *alcaline* Salt in Water, they being mixed with this mineral Water, the Mixture grew milky, and a little after a white Precipitate ſettled. This happens when a fixed or a volatile alcaline Salt meets with a neutral Salt; then they join together, and ſomewhat of the alcaline Earth falls down.

Milk mixed with a mineral Water, and boiled in equal Proportion, will make a Separation, by meeting with either an *acid* or *alcaline* Salt in it, or, by finding of the laſt Salt, the Mixture will change red; but our mineral Water may be boiled with it in ſeveral Proportions, without any Change or Precipitation.

According to theſe Experiments, there is no *acid Salt* in this Water.

To ſee whether there is no *Iron* or *Copperas* in it,

If the *Solution* of *Galls* is mixed with any Liquor, and grows black, then it is a Sign of *Iron* or *Copperas*; but our mineral Water, mixed with it, turned a little browniſh, becauſe of the Salt in the Water.

To know whether there is any *Brimſtone* in a mineral Water, it is to be inquired with a poliſhed Piece of Silver, which, being put in the Water, will turn black or yellowiſh; but this did not happen with this Water.

To find out the *acidum ſalinum* in a mineral Water, you muſt mix with it *Solutio Argenti*, which turns inſtantly *white*, and a light Precipitate falls, being the *Luna Cornea.*

A Solution of *Saccharum Saturni*, mixed with the Water, yields the *Magiſterium Saturni.*

All the above-mentioned Experiments certify, that our mineral Water contains no *alcaline* nor *acid Salt*, no *Iron*, *Copperas*, or *Brimſtone*: Therefore from the ſame Experiments it is evident, that the *Chiltenham*

Water conſiſts of a *Sal medium fixum vel neutrum*, and a diſſolvable *Terra alcalina vel cretacea*, which may be ſeparated.

By a *Sal medium*, is to be underſtood a Salt being neither of an *alcaline* nor an *acid* Nature; and that will not precipitate any Solution made with ſuch Salts, nor, mixed with the Syrup of Violets, will change it's Colour.

Theſe neutral Salts have always their Origin from an *alcaline* and an *acid Salt*; and, according to the *alcaline Salt* they meet with, ſo they are qualified. So we have the *Tartarus vitriolatus*, conſiſting of the *Sal alcali fixum*, and *Acidum vitriolicum*.

The *Arcanum duplicatum* of the *Sal alcali*, Salt-petre, and *Acidum vitriolicum*.

The *Sal Mirabile* GLAUBERI, conſiſting of common Salt, and it's *Terra fluxilis*, and an *Acidum vitriolicum*; but with this Difference, that the *Sal Mirabile* will ſoon melt in a Crucible with a gentle Fire; but *Tartarus vitriolatus*, *Arcanum duplicatum*, *&c.* will not melt, even with the ſtrongeſt Heat, becauſe of the Difference of the Earth in the alcaline Salt, which in the common alcaline Salt is very fixed, but in the common Salt very volatile and fuſible.

Such a *Sal medium* as the *Sal mirabile* we find in this mineral Water, yet mixed with ſome common Salt.

As for the Bitterneſs of this Water, there is no other Reaſon for it than the *Terra Cretacea*, which is proved by the *Epſom-Salt*, where the *Terra alcalina Salis communis*, joined with the *Acidum vitriolicum*; and after the ſame Manner in the *Sal mirabile*, the alcaline Earth cauſes the bitter Taſte. The ſame may alſo be found, by mixing Quick-lime with Spirit of Vitriol, and it will produce a very bitter Taſte; but the Mixture of Quick-lime with Spirit of Nitre cauſes a Bitterneſs which exceeds Gall.

One Pound *Troy* of this Water yields 29 Grains of the ſaid *Sal medium*, and 3 Grains of the Earth.

Remarks by C. M. Ibid. *p.* 834.

2. The R. Hon. Lord *Cadogan* had communicated a ſhort Account of theſe Waters to the *Royal Society* on *April* 17, 1735, being a Letter his Lordſhip had received from Mr *Tho. Dundaſs*, Surgeon to his Lordſhip's Regiment, dated at *Glouceſter*, *March* 25, 1735, wherein he gives an Account of ſome few Experiments he had made on theſe Waters, which moſtly agree with the preceding ones; as that there were no Marks of a chalybeat Nature in them; nor any Signs of *Nitre* or *Sulphur*: But that ſix Quarts of this Water being diſtilled very carefully, the Sediment at the Bottom of the Veſſel was nothing more than *Alum* and *Sal Gem*, to which it owes it's *purgative Quality*. Some of the Salt of this Water, being put into a Solution of Silver, quickly made a Precipitation of the Silver. Mr *Dundaſs* ſays, that ſome alcaline Liquors, as *Oil of Tartar*, Spirit of *Sal Ammoniac*, *&c.* being dropt into ſome of the Water, immediately produced a violent Effervеſcence; which plainly ſhews a great *Acidity*, which he aſcribes to the *Alum* in

this

this Water. M. *Senckenberg* found no such Effervescence on mixing these two alcaline Liquors with the Water; but only says it grew milky, and a little white Precipitate subsided. I can account for this material Difference no otherwise, than by supposing, that the *Acid*, which caused the Effervescence in Mr *Dundas*'s Experiment, was a volatile *Gas*, which was not quite spent in being carried no farther than *Glocester*, but which was quite evaporated and flown away before the Water came into M. *Senckenberg*'s Hands in *London*: And as to the *Alum*, Mr *Senckenberg* did not attend to it.

"Mr *Dundas* thinks these Waters may be of Use in a lax Constitu-
"tion, when the Humours are of an *alcalescent* Nature; but, when
"*acescent*, must do Hurt."

VIII. *Dulwich* is a Village lying about 6 Miles S. of *London*, at the Foot of that Ridge of Hills which divides the Counties of *Kent* and *Surrey*. The Purging-Springs, which have been esteemed for about 100 Years, and are commonly known by the Name of *Dulwich-Waters*, have been improperly so called; those Springs arising in a Valley on the S. Side of those Hills, in the Middle of a large Common belonging to the Parish of *Lewisham* in *Kent*; whereas *Dulwich* is on the North Side of the Hills, in the Parish of *Camberwell* in *Surrey*.

There has not been any medicinal Spring observed in *Dulwich*, before that which is the Occasion of this Discourse.

An Account of a new Purging-Spring discovered at Dulwich *in* Surrey, *by* John Martyn, *F. R. S.* Prof. Botan. Cantab. Ibid. *p.* 835.

In the Autumn of 1739, Mr *Cox*, the Master of a well-known House of good Entertainment, called the *Green Man* at *Dulwich*, lying about a Mile beyond the Village, was desirous to dig a Well for the Service of his House, there being no Spring of good Water near it. And as it was probable, that he would be obliged to dig pretty deep, I was willing to observe what *Strata* of Earth he dug through. The first 20 Feet in Depth seemed to be only the Clay, which, in a long Tract of Time, had been washed off from the steep Hill, at the Foot of which his House is situated. It was intermixed with Pieces of Roots and Leaves, and with other Fragments of vegetable Substances. In digging 40 Feet deeper, the Clay was found of various Colours, brown, blueish, and black, intermixed with a considerable Number of *Pyritæ* or Copperas Stones, and some pretty large Masses of the Waxen-vein or *Ludus Helmontii*, which is also found in great Plenty on the Sea-Shore near the *Spaw* at *Scarborough*.

The Well being digged to the Depth of 60 Feet, and no Water appearing, Mr *Cox* caused it to be covered up, and gave himself no farther Trouble about it that Winter. The following Spring, on my coming down, it was opened. I found 25 Feet of Water, of a sulphureous Smell and Taste, which went off, after the Well had been opened some Days.

As I had a strong Suspicion, that this Water was impregnated with some Mineral, I made an Inquiry into the Nature of it by the following Experiments:

I. It

1. It curdled Milk.

2. It became green, when mixed with Syrup of Violets, which Colour disappeared in a few Days.

3. Being poured on Green Tea, it did not acquire any Colour.

4. Being mixed with powdered Galls, it acquired a deeper brown Colour than Rain-Water did, and continued turbid; whereas the Rain-Water continued clear, after the Galls were subsided.

5. Being shaken in a close-stopped Phial, it disploded a Vapour on opening the Phial before the Commotion ceased, with a more audible Noise than common Water did.

6. Being mixed with Oil of Vitriol, and Oil of Tartar, a much more considerable Ebullition was raised, than by the Mixture of those Liquors with Rain-Water.

7. Six Quarts of this Water, being boiled to a Pint, let fall a large Quantity of a fine, whitish, insipid Powder; and the Water so boiled had a very strong saline Taste, with a Mixture of Bitterness, not unlike the *Sal cartharticum amarum.*

8. It let fall a copious white Sediment, on the Addition of the Oil of Tartar, which has the same Effect on a Solution of Alum, or of *Sal catharticum amarum.*

9. The boiled Water, after it had deposited it's Earth, precipitated large white Flakes, on the Addition of Oil of Tartar.

10. It differs from a Solution of common Salt. For the Oil of Tartar, being dropped into that Solution, caused only a slight Precipitation, which was soon afterwards absorbed again by the Water.

11. It does not lather with Soap.

Having made these Experiments, I was satisfied, that this new Spring was really a Purging-Water, as it has since been found by Experience. Some of Mr *Cox*'s Family drank of it with Success, which encouraged several other Persons to try it, to their great Advantage.

Being drank fresh, in the Quantity of 5 Half-pint Glasses, it purges quickly, not sinking, but raising the Spirits.

It is found to be very diuretic.

These Properties of the *Dulwich-Water* do not seem to be owing to any of the Materials found in digging the Well. The *Pyritæ* are known to be a Mixture of Iron and Sulphur; but this Water seems to have hardly any Parts of Iron in it [Exp. 3 and 4]. The Spirit, with which it abounds, [Exp. 5 and 6] may, perhaps, be owing to a Fermentation of the Sulphur, which is continually flying off, as appears by the strong Smell of it, after it has been for some Time covered up. And Mr *Cox* has lately informed me, that a Silver Cup, which has been often used in drinking this Water, has acquired a yellowish Colour.

The *Ludus Helmontii* affords nothing but Iron: Nor does the Clay, through which they dug, discover any Salt in it's Composition. We may therefore conclude, that the Hill, which lies between the old Wells

and

and this new one, contains the purging Salt, with which theſe Waters are impregnated.

I do not find any material Difference between the old and new Waters, except in the Convenience of drinking them. The old Wells are at a Diſtance from any Houſe, except ſome few Huts, and expoſed to the Rain and Land-Floods, by which they are often injured: The new Well is a Mile or two nearer to *London*, well ſecured from any Injuries of the Weather.

December 11, 1740.

Deſcription of a Water-Spout ſeen about Sun-ſet, May 21, 1732, *Lat* 32° 30′ *N. Long.* 9° *E. from the Meridian of* Cape Florida, *by Mr* Joſeph Harris. No. 428. *p.* 78. Apr. *&c.* 1733. Fig. 45.

IX. When firſt we ſaw the *Spout*, it was whole and entire, and much of the Shape and Proportion of a Speaking-Trumpet, the ſmall End being downwards, and reaching to the Sea, and the big End terminated in a black thick Cloud. The Spout itſelf was alſo very black, and the more ſo the higher up. It ſeemed to be exactly perpendicular to the Horizon, and it's Sides perfectly ſmooth, without the leaſt Ruggedneſs. Where it fell, the Spray of the Sea roſe to a conſiderable Height, which made ſomewhat of the Appearance of a great Smoak.

From the firſt Time we ſaw it, it continued whole about a Minute, and 'till it was quite diſſipated about 3′. It began to waſte from below, and ſo gradually up, whilſt the upper Part remained entire, without any viſible Alteration, 'till at laſt it ended in the black Cloud above. Upon which there ſeemed to fall a very heavy Rain in that Neighbourhood. As it waſted, the Bottom of the remaining Part was irregular, ſomewhat like the Trunk of a Tree broken aſunder: There was but little Wind, and the Sky elſewhere was pretty ſerene. We judged the Spout to be above 2 Leagues off, and I think the Angle under which the ſmall End appeared, muſt be at leaſt 20′. According to which Eſtimation, the Thickneſs of it muſt be upwards of 60 Yards, and it's Height or Length about $\frac{3}{4}$ of a Mile.

CHAP. III.

MINERALOGY.

An Account of the damp Air in a Coal Pit of Sir James Lowther, *Bart. ſunk within* 20 *Yards of the Sea; communicated by him to the* R. S.

I. SIR *JAMES LOWTHER* having Occaſion to ſink a Pit very near the full Sea-Mark, for the draining one of his principal Collieries near *Whitehaven*, in the County of *Cumberland*, which was known would be near 80 Fathom in Depth to the beſt Seam of Coals, which is 3 Yards thick; the Work was carried on Day and Night very ſucceſsfully, through ſeveral Beds of hard Stone, Coal, and other Minerals, 'till the Pit was ſunk down 42 Fathom from the Surface, where they came to a Bed of black Stone, about 6 Inches thick, very

No. 429. *p.* 109. July, &c. 1733.

very full of Joints, or open Cliffs, which divided the Stones into Pieces of about 6 Inches ſquare, the Sides whereof were all ſpangled with Sulphur, and in Colour like Gold. Under this black Stone lies a Bed of Coal 2 Foot thick: When the Workmen firſt pricked the black Stone Bed, which was on the riſe Side of the Pit, it afforded very little Water, contrary to what was expected; but inſtead thereof a vaſt Quantity of damp corrupted Air, which bubbled through a Quantity of Water, then ſpread over that Part of the Pit, and made a great hiſſing Noiſe; at which the Workmen being ſomewhat ſurprized, held a Candle towards it, and it immediately took Fire upon the Surface of the Water, and burned very fiercely; the Flame being about half a Yard in Diameter, and near 2 Yards high, which frightned the Workmen ſo that they took the Rope, and went up the Pit, having firſt extinguiſhed the Flame, by beating it out with their Hats; the Steward of the Works being made acquainted with it, went down the Pit with one of the Men, and holding a Candle to the ſame Place, it immediately took Fire again, as before, and burnt about the ſame Bigneſs; the Flame being blue at the Bottom, and more white towards the Top. They ſuffered it to burn near half an Hour, and no Water being drawn in that Time, it roſe and covered the Bottom of the Pit near a Yard deep, but that did very little abate the Violence or Bulk of the Flame, it ſtill continuing to burn upon the Surface of the Water. They then extinguiſhed the Flame as before, and opened the black Stone Bed near 2 Foot broad, that a greater Quantity of Air might iſſue forth, and then fired it again; it burned a full Yard in Diameter, and about three Yards high, which ſoon heated the Pit to ſo great a Degree, that the Men were in Danger of being ſtifled, and ſo were as expeditious as poſſible in extinguiſhing the Flame, which was then too ſtrong to be beaten out with their Hats; but with the Aſſiſtance of a Spout of Water, of 4 Inches Diameter, let down from a Ciſtern above, they happily got it extinguiſhed without further Harm. After this no Candles were ſuffered to come near it, 'till the Pit was ſunk down quite through the Bed of black Stone, and the 2 Foot Coal underneath it, and all that Part of the Pit, for 4 or 5 Foot high, was framed quite round, and very cloſe jointed, ſo as to repel the damp Air, which nevertheleſs, it was apprehended, would break out in ſome other adjoining Part, unleſs it was carried quite off as ſoon as produced out of the Cliffs of the Stone; for which End a ſmall Hollow was left behind the Framing, in order to collect all the damp Air into one Side of the Pit, where a Tube, of about 2 Inches ſquare, was cloſely fixed, one End of it into the Hollow behind the Framing, and the other carried up into the open Air, 4 Yards above the Top of the Pit; and through this Tube the ſaid damp Air has ever ſince diſcharged itſelf, without being ſenſibly diminiſhed in it's Strength, or leſſened in it's Quantity, ſince it was firſt opened, which is now 2 Years and 9 Months ago: It is juſt the ſame in Summer as in Winter, and will fill a large Bladder in a few Seconds, by placing

a Funnel

Pla. VI. *Vol. VIII. part 2. page 656.*

Fig. 45.

a Funnel at the Top of the Tube, with the ſmall End of it put into the Neck of the Bladder, and kept cloſe with one's Hand.

The ſaid Air being put into a Bladder, as is above deſcribed, and tied cloſe, may be carried away, and kept ſome Days, and being afterwards preſſed gently through a ſmall Pipe into the Flame of a Candle, will take Fire, and burn at the End of the Pipe as long as the Bladder is gently preſſed to feed the Flame, and when taken from the Candle, after it is ſo lighted, it will continue burning 'till there is no more Air left in the Bladder to ſupply the Flame. This ſucceeded in *May* laſt before the *Royal Society*, after the Air had been confined in the Bladder for near a Month.

The Air, when it comes out at the Top of the Tube, is as cold as froſty Air.

It is to be obſerved, that this Sort of Vapour, or damp Air, will not take Fire except by Flame; Sparks do not affect it, and for that Reaſon it is frequent to uſe Flint and Steel in Places affected with this Sort of Damp, which will give a glimmering Light, that is a great Help to the Workmen in difficult Caſes.

After the damp Air was carried up in a Tube, in the Manner above deſcribed, the Pit was no more annoyed with it, but was ſunk down very ſucceſsfully through the ſeveral Beds of Stone and Coal, without any other Accident or Interruption, 'till it came to the main Seam of Coals, which is 3 Yards thick, and 79 Fathom deep from the Surface; and the ſaid Pit being oval, *viz.* 10 Foot one Way, and 8 the other, it ſerves both for draining the Water by a Fire-Engine, and alſo for raiſing the Coals.

Whitehaven, Aug. 1, 1733.

An Experiment to ſhew that ſome Damps in Mines may be occaſioned only by the burning of Candles under ground, without the Addition of any noxious Vapour, even when the Bottom of the Pit has a Communication with the outward Air, unleſs the outward Air be forcibly driven in at the ſaid Communication or Pipe. By the Rev. J. T. Deſaguliers, *LL D. F. R. S.* No. 442. *p.* 281. July, *&c.* 1736.

II. Exp. 1. In a cylindric Glaſs Receiver, open at both Ends, whoſe lower End is plunged in Water, and upper End covered with a Plate with an Hole of near an Inch Bore, a Candle of ſix in the Pound will not burn quite the Time of one Minute before it goes out.

Exp. 2. A Candle will burn almoſt as long when the Receiver is quite covered.

Exp. 3. The Receiver having the Hole of the Plate open, and a Pipe at Bottom communicating with the external Air, will burn but a little longer than in the firſt Experiment; and if you blow in at the Pipe with your Mouth, it will go out rather ſooner.

Exp. 4. Blow in at the Pipe with Bellows, and the Candle will burn as long as you will.

An Obſervation of an extraordinary Damp in a

III. 1. In *June* 1733, a Farmer, in Hopes of finding a perpetual Spring of good Water, ſunk a Well, whoſe Diameter was 7 to the Depth of 45 Feet; (through a Soil whoſe Surface was a Kind of Brick

Well in the Iſle of Wight, *by* *Mr* Benj. Cooke, *F.R.S.* No. 450. *p.* 379. Oct. *&c.* 1738.

Earth mixed with Sand, which in deſcending became almoſt wholly hard, coarſe, yellow Sand) which Work employed the Labourers about 20 Days, without finding the leaſt Appearance of Water.

At the Diſtance of about 18 Feet from the Top, a *Stratum* of a mineral Mixture, about 9 Inches thick, was dug through, without any Inconvenience; nor were the Workmen in the leaſt incommoded in carrying on the Work, till about the 12th Day after, when towards the Evening they were much annoyed with a faint ſuffocating Heat, (which they compared to that coming from the Mouth of an Oven) and which, as they were drawn up, was moſt remarkably perceived, when they came oppoſite to the mineral *Stratum* above-mentioned, to come out in the Form of a warm ſulphureous *Halitus*.

The next Morning, a luſty young Man attempted to go down (Hand over Hand, as the Workmen call it) by Means of a ſingle Rope which was uſed to draw up the Earth digged out; but as ſoon as he came oppoſite to the above-mentioned *Stratum*, he became incapable of ſuſtaining his own Weight, fell down to the Bottom, and died immediately.

Another young Man, not ſuſpecting the Cauſe, had the Rope nimbly drawn up; and having ſeated himſelf aſtride a Croſs-ſtick fixed to the Rope for that Purpoſe, was haſtily let down to his Friend's Aſſiſtance; but when he came to the ſame Diſtance from the Top, he was obſerved to give the Rope a very great Shock, and when he came to the Bottom, fell down, as the other had done before him, was ſeized with violent Convulſions, which held him more than a Quarter of an Hour, and then he expired.

A third Perſon, in Hopes of fetching up this ſecond before he was quite dead, was tied faſt into a large Baſket, and let down with more Caution; but when he came to the ſame *Stratum*, finding his Breath going, (as he expreſſed it) he cried out, and was drawn up again; but remained in the open Air, for the Space of near half an Hour, pale as dead, panting and ſpeechleſs.

The dead Bodies were, within 3 Hours Space, drawn up by the Help of a Sort of Tongs, uſed to fetch Things up from the Bottom of the Sea; but brought ſuch a diſagreeable Stench in their Cloaths with them, as made ſeveral hardy Men, who aſſiſted in doing of it, vomit.

The next Day a Cat was let down, and at the ſame Place ſeized with Convulſions; but being drawn quickly up again, ſoon came to herſelf; which Experiment was repeated ſeveral Times for ſome Weeks following, by which it was found, that this deſtructive Vapour was ſometimes of a greater and ſometimes leſſer Force, and ſometimes quite gone, ſo that the Cat felt no Uneaſineſs; and a lighted Candle, which would ſometimes be immediately extinguiſhed as ſoon as it ſunk below this deadly *Stratum*, would burn clearly at the very Bottom.

It was very remarkable, that there was a whitiſh Fog in the Well, ſo thick that one could but juſt ſee the dead Bodies through it.

Water

Water being ſcarce in that Place, the Well was left open for about 8 Months, in Hopes the Damp might at laſt wholly leave it; but inſtead of ſo doing it became worſe; and not confining itſelf within it's firſt Bounds, it overflowed at the Top, where, when the Air was moiſt, it appeared like a thin white Fog; and when the Air was dry, could be perceived like a warm Breath, at all Times diffuſing a ſulphureous Stench, (ſomething like that which ariſes from Fileings of Iron, while corroding with Vinegar) affecting thoſe who came into it with a Giddineſs, Shortneſs of Breath, and Propenſity to vomit; ſo that at laſt the Well was filled up, being troubleſome to the Family which lived near it.

I have ſent you a little Quantity of the *Stratum* above-mentioned, which is continued to the neighbouring Clift, where, when heated with the Summer's Sun, it gives a noiſome ſulphureous Smell, and is, after moderate Rains, covered with a yellowiſh efflorescent Salt, very aſtringent and acid.——On the Shore below there are gathered *Pyrites*.

2. I have recollected ſome further Obſervations on the Damp. The Vein which was cut through in the Middle of the Well, from whence were emitted the fatal *Effluvia*, is a crude Ore made up with Iron, Sulphur, and acid Salts, mixed with *Pyrites*. *A farther Account by the ſame.* Ibid. *p.* 382.

Theſe *Effluvia* were not perceived till after the Vein had imbibed the Air for ſeveral Days.

Whilſt the Air continued dry, theſe *Effluvia* ſubſided, and lay in the lower Part of the Well, which ſeemed filled near to an exact Level with the *Stratum* from whence they came.

But when the Weather became rainy, the Quantity as well as the *Impetus* of the *Effluvia* increaſed to ſuch a Degree, as to appear in Mornings over the Top of the Well, in the Form of a Miſt, and gave great Annoyance to thoſe that came within it's Sphere of Action.

From hence it is worth obſerving, that the ſame Damp, according to the Variation of the Weather, is ſpecifically heavier or lighter than the Air.

IV. The Quarry at *Pyrmont*, 800 Paces from our chalybeat Springs, has been uſed theſe 100 Years for Stones to build the neighbouring Houſes. When I was building my own Houſe 20 Years ago, and often went into the Quarry, the Workmen told me, that they frequently found dead Birds in a deeper Pit, and ſometimes ſhewed me ſeveral Sorts of Birds newly dead. *An Account of a ſulphureous vaporiferous Cavern in the Quarry at* Pyrmont, *like the* Grotto del Cane *at* Naples, *by* Jo. Phil. Seip, *M. D. Aulic Counſellor and chief Phyſ. to the Pr. of* Waldeck, *and F. R. S.* No. 448. *p.* 266. June, *&c.* 1738.

I ſuſpected at firſt, that ſome poiſonous mineral Matter, like Smalt or Orpiment, might be mixed with the Stones, and diſſolved by the Rain-Water, of which the Birds might have drunk. But when I went into the Pit myſelf, and leaned down my Head to take out the Birds, I was immediately ſtruck with a moſt penetrating Smell, ſo that I was obliged to retire, being giddy and aſthmatic.

Thus the Myſtery was diſcovered, and I judged this ſuffocating ſulphureous Steam to be of the ſame Original and Nature with that,

which we obſerve in our Fountains, in fair, calm, and dry Weather, in the Mornings and Evenings, where Birds are ſuffocated in an Inſtant, and Ducks ſwimming in the great Spring, uſed for a Bath, can ſcarce ſubſiſt a few Moments.

I was ſo far from thinking it adviſeable, that I rather judged it would be dangerous to our chalybeat Springs, to make more of thoſe Chimneys, and ſo let out the ſulphureo-ſpirituous Vapours from the Inſide of the Mountains, which ought rather to be kept in to ſharpen the ſubterraneous Waters.

For this Reaſon, and on my Repreſentation, the Prince of *Waldeck* forbad the Workmen to dig any deeper into the Quarry, and ſo to let out the mineral Steams. Only I begged of his Highneſs one ſquare Pit, of 6 Feet on each Side, to uſe ſometimes as a dry Bath, and about 12 Years ago I covered it with an Arch, and ſhut it up with a Door. This little Cavern, defended and confined by Walls, cannot defraud our chalybeat Springs of their ſulphureo-ſpirituous Virtues, ſince it is certain, that this Vapour does not always riſe, but only when the Weather is mild and ſerene, the Winds E. and N. dry and not ſtormy, but blowing gently, and when Fogs and Vapours riſe before Thunder.

The Steam alſo is found only in Mornings and Evenings; and as the Sun aſcends gradually in the Day-time, ſo the Vapour deſcends, and towards Noon goes quite under the Stones, and entirely vaniſhes. About Evening it begins to return; and after Sun-ſet comes out again plentifully. This Steam is not like watery Vapours and Fogs, and never ſhews itſelf viſibly, except in the Sun-Beams, when the tremulous Motion of the Vapour ſhews it as if it flaſhed from the Stones at ſhort Intervals.

The Steam is generally confined within a certain horizontal Line, and ſeldom riſes and exerts it's Power above 1, 1 ½, and 2 Feet. Therefore if any one goes down into the Pit, let him ſtand upright in it, and not bow his Head below the Line, and he will not perceive any Smell, or have his Organs of Reſpiration affected. But at certain Times, eſpecially when the Air is calm and very dry, with violent Thunder and Lightning, the Vapour riſes, and exerts it's noxious Effects to the Height of 5 or 6 Feet or more; but this ſeldom happens.

I have obſerved the following *Phænomena* in this mineral Steam.

1. On going into the Cavern, and ſtanding erect, one perceives no Smell at all; but in a few Moments the Feet grow hot, and the Steam penetrates quickly through the Shoes, and excites a ſtimulating Senſation in the Skin, as if it was ſtung with Nettles, which gradually extends itſelf to the Legs and Thighs, warming the lower Parts, as if they were near a Fire.

If you ſtand quiet in this Manner for a ſhort Time in the Pit, the Sweat is drawn out, firſt in the lower Parts, afterwards all over the Body, without any Trouble or Uneaſineſs.

2. Thoſe

2. Thoſe who bow down their Heads to the Bottom of the Pit, preſently perceive a moſt penetrating Smell; their Reſpiration is ſuppreſſed; the Eyes water, and are ſenſible of ſuch an Acrimony as proceeds from Onions and Horſe-radiſh; the Mouth is filled with a ſulphureous Taſte; the Head is giddy and drowſy; ſo that they are in Danger of falling down and being ſuffocated.

3. All Sorts of Inſects, as ſoon as they touch the Vapour, fall down and die.

4. Sometimes the ſmaller Birds, if the Steam is very copious, are ſuffocated in the very Moment of their Entrance; but they often ſeem for ſome Moments to be convulſed, flutter, jump, gape, and imitate the Geſticulations of ſuch Animals as are deprived of Air; and at laſt expire.

If Care is taken to obſerve exactly when the Birds drop, and begin to faint, before they are quite dead, and to carry them immediately into the open Air, eſpecially if Air is blown into their Mouths, they awake as it were from a profound Sleep, revive, and ſoon come to themſelves, ſo as to eſcape entirely without any Loſs of Life or Health. In this Manner I have treated a Bird 10 Times in one Day, and have afterwards preſerved him a long Time alive.

5. The larger Birds and domeſtick Fowls continue longer in our Pit, eſpecially if they can ſtretch their Necks above the Line, or by frequent Leaps get above the Sphere of Vapour, and ſo breathe the free Air by Intervals; but if the Vapour is copious, or their Heads are kept at the Bottom of the Cavern, they ſuffer in like Manner with the ſmaller Birds.

6. The larger and ſtronger any Quadruped is, the longer it eſcapes Suffocation, but at laſt they all drop like the Birds. But they recover much more eaſily in the open Air, eſpecially if they are plunged into Water, or ſprinkled plentifully therewith.

7. Our Vapour preſently extinguiſhes Fire, eſpecially Flame, and Candles, either open or in Lanterns.

It is a pleaſant Experiment to ſet a Bundle of Straw on Fire, and hold it down to the Bottom of the Cave; for the Flame is preſently extinguiſhed; if you raiſe it again into the free Air above the Sphere of the Vapour, it immediately burſts into Flame again, and you may repeat this as often as you pleaſe.

8. When the Vapour is copious and ſtrong, Gun-powder will not catch Fire at the Bottom of the Pit. Sparks from Flint and Steel fall upon Gun-powder, but do not fire it.

In 1724, when I firſt incloſed the Pit, I conſidered how I might apply to the Health of Man this wonderful Vapour, which is much more ſubtile and penetrating than any of our chymical Spirits: For I did not find the Vapour to be arſenical, or corroſive, like that which riſes from burning Sulphur. It does not adhere to the Lungs, and corrode them, but only takes away the Air, and obſtructs Reſpiration:

But

But this Effect is not ſo ſudden on Man, but that he may have Time to remove himſelf with Safety. I have often, by Way of Experiment, ſtaid in the Cave as long as I could bear the Vapour, to the very Point of Fainting and Suffocation; I have opened my Mouth to draw in the Vapour, and at laſt recovered by leaping into the open Air. I never found any Inconvenience from this, but rather felt my Breaſt and Reſpiration lighter; and ſometimes, when I have had a Defluxion and Cough, I have found the Obſtructions to be diſſolved and diſſipated by this Fumigation.

There is not under Heaven a more ſhort and eaſy Method of raiſing a Sweat; for after a few Moments Stay in this vaporous Cave, the whole Body flows with Sweat.

The Country People have ſometimes found great Relief here from Swellings of the Feet, Rheumatiſms, and arthritic Pains of the Joints. But becauſe the Vapour ſometimes riſes above it's uſual Sphere, and then is too ſtrong and intolerable, I have been afraid, leaſt any raſh Perſon, making too long a Stay in the Cave, might loſe his Life; for which Reaſon I have not ventured to make ſo hazardous an Experiment.

Pyrmont Wells,
May 12, 1736. *N. S.*

An Account of the icy Cave of Szelicze, *by* Matthias Belius, *F. R. S. No.* 452. *p.* 41.

V. At the Foot of the Mountain *Carpathus*, toward the South, lies the County of *Thorn*, which takes it's Name from the Tower of *Thorn*. It's Limits are reſtrained within a narrow Compaſs by the Hills, which are prodigious. Among theſe may be reckoned the Mountain which riſes between *Szelicze* and *Borſua*; not that it is bigger than the others; but becauſe of it's extraordinary Appearance, of which we are now going to give an Account.

The Village of *Szelicze* is ſituated among Woods and Foreſts; it is hilly and barren, the Weather is rough, and the Air cold, with ſtrong and almoſt continual N. Winds, which blowing from the high and ſnowy *Carpathus*, make the Air ſo cold, that Flies and Gnats cannot live there, when it is warm in all the Country round about. Near this Village the Cave, of which we are ſpeaking, opens from the Mountain above-mentioned, with a great Mouth toward the N. For it is 18 *Orgyiæ* high, and 9 broad; whence it is ſufficiently accommodated for the full Reception of the N. Wind. The deep and ſubterraneous Paſſages of the Cave wind toward the S.

When the Cold is ſevere in the Country, the Air within the Cave is warm; but it freezes there, when the Sun ſhines with the greateſt Heat. When the Snow is melted, and Spring begins, the inmoſt Part of the Cave, which lies toward the meridian Sun, emits a limpid Water, which being frozen into a tranſparent Ice, by the Power of the internal Cold, forms Icicles, that hang down, as thick as large Tubs, branching out into many ſurprizing Forms. The Water, which happens

pens to fall on the ſandy Ground, is ſaid to freeze ſooneſt. Thus not only the Arches, which are formed by Nature in the ſolid Rock, but alſo the Floor of the Cave is covered thick with clear Ice. This Ice ſhines ſo all about the Cave, that you would think it was incruſted with Cryſtal.

This unuſual Sight is the more ſurpriſing to the Beholders, as the Cave grows broader and deeper. That Part of which is paſſable, is 50 *Orgyiæ* deep, and 26 wide, and of unequal Height. The Receſſes beyond this are ſo ſteep as to be inacceſſible. Nor has any one yet attempted to go farther down this ſlippery Precipice, which would require to be cut into Steps with vaſt Labour. Some have attempted to ſound it with a Plummet, but as the Deſcent is not perpendicular, like a Well, but breaks out into various Windings, the Experiment has proved fruitleſs. Thoſe have ſucceeded beſt, who have fired Muſkets well charged into it: For the Report has laſted ſeveral Minutes, with a very great Eccho, like a long rolling Clap of Thunder; which ſhews that the Cave is very deep, and has many winding Receſſes.

The freezing Diſpoſition of this Cave increaſes with the Heat of the Sun. At the Beginning of the Spring, the Winter Warmth begins to leſſen; as the Spring comes on, the Cold of the Cave increaſes in Proportion to the outward Warmth. But when the Summer is advanced, and the Heat of the Air is the greateſt, then all within is Winter, and the Froſt moſt intenſe. Then all the Drops, which diſtil from the Vault, are frozen till they are increaſed to the Bulk of large Caſks, and appear like the Ruins of broken Rocks. The Exudations from the Sides of the Cave are formed into aſtoniſhing Incruſtations, which are ſpread like Carpets wrought with the exacteſt Art. The reſt of the Ice adheres mutually, according to the Viciſſitudes of the Heat without. For if the Heat is continual and vehement, a greater Quantity of Ice is added to the Icicles, and to the Sides and Bottom of the Cave; but if the Heat happens to be moderated by N. Winds, or falling Showers, the Waters are more ſlow in freezing, and the Ice itſelf gives, and begins to form little Rivulets: But when the Heat increaſes again, the Cave returns to it's icy Temper. Some have obſerved, that it predicts the Viciſſitude of the Weather as well as a Barometer. For if the outward Air is beginning to grow hot, the Waters within the Cave will freeze hard ſome Hours before the Heat is ſenſible: And, on the contrary, the Ice will give ſome Hours before the outward Air grows cool.

The Nature of this Cave furniſhes it with ſuch a Quantity of the cleareſt Ice, that 600 Waggons loaded every Week would not be ſufficient to exhauſt it. It is cuſtomary with the Inhabitants, when they are at Leiſure, to fetch out the Ice to cool their Liquors, and frequently melt it into Water to drink. They have a high Opinion of it's Wholſomeneſs, and think it is lighter on the Stomach, and more

eaſily

eaſily diſcharged through the Pores or Bladder, than other Water, and not without Reaſon.

There are however different Climates in this Cave. At the firſt Entrance there is a pleaſant Air, like an *Eteſian* Gale. A few Steps farther it grows cold; if you proceed, it makes you ſhiver, and you are glad to button up your Cloaths, which you wore open before you came in. But if you deſcend farther, the Cold is ſo ſevere as to be almoſt intolerable: But when the autumnal Nights begin to grow cold, the Ice begins to melt, and as the Cold increaſes, to form Rivulets of Water, till in the Depth of Winter it is all gone, and the Cave is in a Manner dry. Then the Air within is mild and pleaſant, and the Cave becomes a Refuge for Inſects, and other Animals, to eſcape the outward Cold. For beſides ſwarms of Flies and Gnats, and whole Flights of Bats and Owls, the Hares and Foxes retreat hither, till upon the Return of the Spring the Cave reſumes it's icy Nature. The Surface of the Cave, which is expoſed to the meridian Sun, abounds in Graſs, and affords good Paſture for Cattle.

This is the Matter of Fact. Now let us conſider a little, how this unuſual Nature of the Cave may be explained. There are univerſally ſuch Viciſſitudes of Heat and Cold in ſubterraneous Places, that they ſeem to contend with each other. For when the Air without is hot, the Receſſes of ſuch Caves are cold; and they are warm again, when the Air without is cold. This we are taught by daily Experience, in Wine-Vaults, which are not ſunk very deep. For the Effect of Heat is ſuch, that when it beats upon the Earth, an Element thick of itſelf, moiſt, and cold, it drives in it's internal Cold, and greatly condenſes it in Caves formed either by Nature or Art. It is the reverſe, when Cold lies upon the Surface of the Earth; for then it draws from it's inmoſt Bowels the Heat, from what Principle ſoever it is conceived, which makes the Air warm, whereſoever it is capable of diffuſing itſelf through any Caverns. I may here mention an old Cuſtom among my Countrymen, of cooling Wine, all over the champain and hot Country of *Hungary*. For when they travel through vaſt Deſarts, or are obliged to make any Stay in them, where there is neither Ice nor Spring-Water to cool their Liquors; they dig a Pit about 2 Feet deep, and bury their Bottles of Wine in it, covering them over again very cloſe. Then they burn Straw or Reeds over the Place, and when the Fire is out, they dig up their Wine as cool as if it had been put into the coldeſt Water. Whence now is this Cold brought to the Wine? Surely the Fire, which ſuddenly heats the Surface of the Pit, drives the natural Cold of the Earth, condenſed on all Sides, about the Bottles, which at Length pervades them, and renders them agreeable to the Taſte.

Hence we may eaſily conjecture what are the Cauſes of the different Temperatures of the Cave of *Szelicze*. The Power of the outward Heat

Heat beating on the Surface of the Cave, the native Cold of the Earth and Rocks, which form the Arches underneath, firſt makes the Waters cold, and then freezes them: Till, the Air being cooled again, the Heat is drawn forth that is conceived in the inmoſt Bowels of the Earth. When I ſay this, I do not come into the Opinion of *Morin*, who divides the Earth as well as the Air into 3 Regions; the firſt of which is alternately cold and hot; warm in Winter, and cold in Summer, to the Depth of 400 Toiſes, or *Orgyiæ*. The ſecond, he ſays, is always hot, as he himſelf found by Experience in the Mines of *Hungary*. He conjectures that the third is always cold, as being neareſt to the Centre of the Earth; juſt as the middle Region of the Air is always cold, and the upper, which is neareſt the Sky, is always hot. Let *Morin* anſwer for the Truth of this. As for the perpetual Heat of the ſecond Region in the Mines of *Hungary*, it is not always right. None of the *Hungarian* Mines indeed, that I am acquainted with, are ſunk to the Depth of 400 *Orgyiæ*, and hardly any ſo deep as 200 Toiſes, becauſe of the Waters that obſtruct the digging. How then could any one be certain of the Temperature at the Depth of 400 Toiſes? Mines have their different Regions, warm in ſome Places, and cold in others, when they do not exceed 80 *Orgyiæ* in Depth. But let us return to our icy Cave.

Not only the common Cauſe, the incumbent Heat, which has been aſſigned, but the very Poſition of the Cave, and it's Texture contribute to it's Properties. For it gapes wide to receive the N. Winds, which come from *Carpathus*, and are very frequent, and rage chiefly in the Spring and Summer Months, ruſhing down from Mountains covered with Snow, and bringing Particles of Froſt along with them, which entring the Hollows of the Cave, and being condenſed by the outward Cold, eaſily pervade the dropping Water, and conſtringe it into Ice. Beſides the Diſpoſition of the Chambers is to be conſidered, which are all compoſed of Rocks, ſtrongly compacted, ſometimes ſuſtained on high, and ſometimes ſeeming to fall in Ruins. The Nature of the Rocks of *Carpathus* is ſaline, nitrous, aluminous, and vitriolic. Therefore what can be more eaſy, than a copious Generation of Ice in this Cave, from the Mixture of the icy with the other Particles? They will aſſent to this, who have learned the artificial Congelation of Liquors, by repeated Experiments. For Snow or Ice, mixed with an equal Quantity of common Salt, Nitre, Alum, or Vitriol, and put about a Veſſel of Water, freezes it even in the middle of Summer, or near the Fire; not to mention other Experiments.

VI. *Ribar* is a Village in the County of *Zol*, 1 ½ Mile S. from *Neuſol*. In this Country are many warm Baths, which are very beneficial to Health, and of a wonderful Nature. About 600 Paces from theſe Baths, this Cave opens itſelf to the meridian Sun, and emits it's noxious Vapours in a ſmall graſſy Meadow, lying in a fruitful Valley; and has near it an acid Spring, which is good to drink. In former Times, when People were leſs curious, there was hardly any Body that gave Attention

An Account of the Cave of Ribar, *which ſends forth noxious Effluvia, by the ſame.* Ibid. p. 48.

to the uncommon Nature of this Cave. It was therefore in a Manner left to itſelf, overgrown with Buſhes, and ſeldom viſited. It was then in Form of a copious Fountain, and the Water riſing to a good Height, flowed on all Sides, as it does in a Conduit, where the Water flows into a Reſervoir, and then runs over, till it gets into artificial Paſſages. The Water was petrifying; and generating a *Tophus*, formed it by Degrees into ſuch a Maſs, that there grew up a Sort of Hill about the Mouth of the Spring. This tophaceous Stone increaſed by Degrees ſo far, that the Spring itſelf was ſtopped up, not being able to riſe any longer to the Top of the Fountain. This was helped by the Induſtry of the Peaſants, who were glad to ſtop up the Spring, becauſe it did Harm to their Cattle.

This was the ancient State of the Spring, the Footſteps of which appear at preſent on the S. Side of the Meadow, at the Foot of a woody Hill. But afterwards, when plentiful ſubterraneous Veins of Water flowed from the late Fountain in hidden Paſſages, the Ground began to give Way near the old Fountain, and at Length formed a new Opening. Then it began to emit noxious Vapours again, and to be deſtructive to Birds and other Animals. This Cavern gaped in the Form of a Funnel, the Lips of which, being 24 Paces long, and 12 wide, grew narrower by Degrees, till they ended at laſt in a little Hole at the Bottom, whence the noxious Vapour iſſued forth. The murmuring Noiſe of running Water is ſtill heard there, ſo that we may eaſily conjecture, that a River flows through thoſe dark Paſſages, and at laſt loſes itſelf in ſome Kind of Swallows. It has not yet broken out any where, though the Ground ſlopes downward into a Valley, at a ſmall Diſtance from the Cavern.

In 1708 I made ſeveral Trials on the Nature of this Cavern, with the Aſſiſtance of a curious Friend. In the firſt Place, I faſtened a well grown Chicken to the End of a Pike, and held it over the Mouth of the Cave, ſo that the Vapours, as they iſſued, muſt neceſſarily reach it. I had hardly brought it to the Place, when it began to flutter, and in a Moment expired. We opened the Chicken, but only found the Blood ſtagnated in the *Præcordia*; the reſt of the Body was quite ſound. Then I cut ſome Steps in the Ground, and went down myſelf, to obſerve the ſubterraneous Waters; but I was obliged to make more Haſte in going up, than I did in getting down; for my Breaſt began to be obſtructed, and my Head to grow giddy. We wondered that this Vapour ſhould be ſo very noxious, and yet not emit any Sort of Fog, but have the Air above it pure and clear. We therefore endeavoured to diſcover, what Sort of Vapour this could be, which killed Animals ſo ſoon, and yet was imperceptible to the Eyes. We thought, that the firing a Muſket into it, was the readieſt Way to lead us to the Diſcovery. The Cavern thundered with the Noiſe, and emitted Smoak for ſeveral Hours afterwards. We concluded from this Experiment, that the Flaſh of the Powder had ſet Fire to the ſulphureous Exhala-

tions,

tions, which being whirled about, continued to exhale a long Time afterwards. Indeed there was an extraordinary Smell of Sulphur, like what I have obſerved in the Baths, before a Storm.

Having obſerved this ſulphureous Exhalation, it was eaſy to conclude, that the ill Effects of it were owing to a volatile and very ſubtile Sulphur. Therefore we were ſollicitous to get ſome of the Water out of the Cavern, to confirm the Experiment. We were moved to this by the frequent Sight of Birds lying dead about the Hole: For we ſeldom approached it, either in the Morning, or after Dinner, without finding ſome new Deſtruction. We gave great Attention to a Hedge-hog, which in one Night's Time was ſo ſwoln, and it's Skin diſtended in ſuch a Manner, that the Prickles, which otherwiſe adhere ſtrongly enough, ſeemed to be thruſt out by the very Roots. This gave us Room to ſuſpect, that the Animal had not only inſpired the Vapours of the Cavern, but had alſo drunk of the Waters, which boil up violently, and are abſorbed again. The Lungs being livid, and the other Bowels unuſually diſtended, ſhewed that the Animal had both taſted the Water, and ſucked in the Vapour; and it began already to have an ill Smell. We therefore drew up ſome Water from the Bottom of the Cavern, not without Hazard to the Servant, who was let down with Ropes Head foremoſt. It was clearer than Cryſtal, very light, and in a Manner ethereal, of a moderately ſulphureous Smell, with ſomething of acid, and a little Acrimony, but not biting the Tongue or the Palate. In ſhort, they ſeemed to come very near to the Nature of the neighbouring *Acidulæ*. We taſted it at firſt cautiouſly, but being by Degrees confirmed by each other's Example, we at laſt ventured to take large Draughts of it. This we did without any Offence to our Stomachs, though moſt of us were tender enough, being juſt come for the uſe of the hot Springs; nay, ſome were deſirous of mixing it with the generous *Hungarian* Wine.

Theſe Obſervations we have made diligently for ſeveral Years, that we might be enabled to form a Judgment, whether *Agricola* and *Wernher* juſtly call the Exhalations of this Cave peſtilential. A late Writer boldly aſſerts, that all Poiſon proceeds either from a Putrefaction of the Earth, or from I know not what Vitioſity of ſtagnating Humour; each of which Opinions we ſhall now examine. In the firſt Place, though the Vapours of this Cave are mortal, yet they are certainly not peſtilential; for they do not kill Animals by any congenial Poiſon carried along with them; but from other Cauſe, which I ſhall mention afterwards. If theſe Exhalations were peſtilential, the Waters could not be drunk; much leſs could the Animals killed by them, ſuch as Chickens, Thruſhes, Pigeons, and Hares, be eaten, without Loſs of Life, at leaſt of Health; as frequently done by thoſe who bathe in theſe Waters. But you will ſay, perhaps a Putrefaction of the Earth, or Vice of ſome ſtagnating Humour, produces theſe fatal Effects. But it is neither of them: For if you admit this, the Vapours of the Cavern muſt ne-

ceſſarily be thick, and the Water turbid, and of an ill Taſte: Whereas it is clear, and the Taſte not putrid, but ſubacid; beſides, it has been already obſerved, that the Vapours are imperceptible to the Eye. Therefore the fatal Effect of this Vapour muſt be aſcribed to a Quantity of very ſubtile Sulphur, and a Mixture of the Exhalations of the Minerals, which are hurried along, together with the Waters, through thoſe ſubterraneous Paſſages. Not that they are in their own Nature deſtructive, but that their too great Subtilty, filling the *Bronchia* of the Lungs ſuddenly, and ſhutting out the neceſſary Air for Reſpiration, choak up the Blood therein immediately, and kill Animals ſooner than can be imagined. Thoſe who think otherwiſe, are greatly miſtaken, and beſtow an unjuſt Mark of Infamy on our Cavern.

However we may form a Judgment of the ſulphureous Nature of the Exhalations of our Cavern, from the neighbouring Baths, which are of the ſame Nature, but have denſer Streams, and are ſometimes more intenſe, and ſometimes again more remiſs, according to the different Diſpoſitions of the Air. For when the Air is hot, and the Sky diſpoſed to a Storm, the Baths always ſmell of Sulphur moſt intolerably, and are offenſive and ſometimes fatal to thoſe who uſe them; eſpecially when the Waters are freſh let in. I ſaw a ſtrong, hearty Man, in the Vigour of his Age, who bathed one Afternoon, when a great Storm was gathering: He bore the ſulphureous Vapours a great while, but was attacked by a Fever, which carried him off in four Days. I do not know whether our Cavern is ſubject to theſe Viciſſitudes of Weather, for I did not attend to this Obſervation ſo accurately as I ought to have done. This is certain, that, even when the Weather is clear, and there is no Suſpicion of a Storm, the noxious Efficacy of the Vapours varies, and kills the Animals that are brought to it ſometimes ſooner, and ſometimes later; and that it quite ceaſes ſometimes, and as it were loſes it's Nature; the Cauſes of which I have not diſcovered myſelf, nor do I remember, that any of my Friends have made the Diſcovery. The Inhabitants have now covered the Cavern with Boughs in ſuch a Manner, that it is hardly acceſſible. The Deſtruction of Birds alſo is not now ſo frequent as formerly, which I aſcribe to the Watercourſe running deeper than it uſed to do.

A Deſcription of the Cave of Kilcorny *in the Barony of* Burren *in* Ireland, *by Mr* Charles Lucas, *Apothecary at* Dublin. No. 456 *p.* 360. Jan. *&c.* 1740.

VII. That Part of *Ireland* called *Burren*, is a ſmall Barony in the N W Part of the County of *Clare*, and bounded on the North Side by the Bay of *Galway*. It is from one End to the other a Continuation of very high, rocky, Lime-Stone Hills, there being little or no plain Land throughout the whole. It is that Part of which it is reported, that *Oliver Cromwell* ſaid, (when he came to ſtorm a few Caſtles in it) that he could neither ſee Water enough to drown a Man, Wood enough to hang a Man, or Earth enough to bury a Man in: Notwithſtanding it is moſt fertile, and produces immenſe Quantities of Juniper, and ſome Yew; beſides great Variety of the capillary Herbs, *Virga Aurea*, *Verbena*, and ſome other common Plants, I have found the *Teucrium Alpinum*

Alpinum magno flore, of *Caſpar Bauhin*, and a large ſhrubby *Cinquefoil*, anſwering the Deſcription Mr *Moriſon* gives, in his ſecond Volume of *Hiſt. Oxon.* of his *Pentaphylloides rectum fruticoſum Eboracenſe.*

The Inhabitants are but few, and they moſtly poor Cottagers, whoſe chief Stock is a Parcel of Goats. They are courteous and good-natured to Strangers, though very wild and unpoliſhed; weak, blind, ſuperſtitious Zealots to the Church of *Rome*, and (like ſome more polite People in the World) led and enſlaved by a Set of mean, ignorant, and illiterate Prieſts.

The Place where this Cave lies, is called *Kilcorny*: It is a pretty low Valley, in Compariſon to the Hills that ſurround it: The Entrance is into the Eaſt End of it, (for it lies Eaſt and Weſt) about Midway. There are the Ruins of an old Church, and, a little Weſtward of it, an even Plain of about an Acre of Ground; on the North Side of which, under a ſteep rugged Cliff, lies the Cave.

The Mouth of it is level with the Plain, about three Feet Diameter: It has been much larger, but was blocked up with Lime and Stone, which plainly appears ſtill, but to what Purpoſe is not known. Some conjecture it was an Attempt to reſtrain the great Flux of Water; but the fabulous Natives, who tell numberleſs romantic Tales of it, ſay, it is a Paſſage to the *Antipodes*; and that a Stud of fine Horſes have been ſeen coming out of it very often, to eat the Corn ſown in the Valley: They further add, that many Stratagems have been tried to catch ſome of them; but, with the Loſs of ſome Mens Lives, they could catch but one Stone-horſe, the Breed of which, being very valuable, they ſay is kept to this Day by *O Loghlen*, which with them is a Kind of titular King that they pay great Reſpect to. But to return to the Cave:

When you paſs this narrow Entrance, it grows much wider and loftier. The Floor is a pretty even Rock, from 2 to 4 or 5 Yards broad: The Sides and Top are rugged and unequal, from 6 to 12 or 14 Feet high.

About 40 Yards from the Door, there is a pretty deep Pit, 7 or 8 Yards over; but, when paſſed, the Floor is plain and even, as before, for about 200 Yards, which is the fartheſt that any one known has ventured into it: For my Part, I did not paſs this Pit, but have ſeen ſeveral that did, whoſe Veracity I can depend upon. Moſt People that have gone into it, went by a Thread or Clue; others have carried a Bundle of Straw, and dropped it by the Way, to guide their Return; which ſeems altogether unneceſſary, there being no Windings or Chambers throughout of any Extent. It is all over, even in the Depth of Winter, as dry as any Place of the Kind under-ground can be; and what ſeems very prodigious, is, that it often pours forth ſuch a Deluge as covers the adjacent Plain, ſometimes with above 20 Feet Depth of Water;

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The Times of it's overflowing are uncertain and irregular; ſometimes it does not happen above once in a Year or two, but moſt commonly 3 or 4 Times a Year: It is ſometimes obſerved to ſucceed great Rains and Storms, though it often happens without either.

The neighbouring Inhabitants are alarmed at it's Approach, by a great Noiſe, as of many falling Waters at a Diſtance; which continues for ſome Hours before, and generally all the Time of the Flood.

The Water comes forth with extreme Rapidity from the Mouth of the Cave, and likewiſe from ſome ſmaller Holes in the low Ground, attended with a ſurpriſing Noiſe: It flows for a Day or two, and always returns into the ſame Cave, and partly into the ſmall Holes, from whence it was obſerved to come before, but with a more ſlow and tardy Courſe. The Water is of a putrid Quality, like ſtagnated Pond-Water, inſipid as Spring-Water. It always leaves a filthy muddy Scum upon the Ground it covered, which greatly enriches the Soil.

It has been known ſometimes (though rarely) to overflow and ebb in 6 or 8 Hours Time, but in a much leſs Quantity.

There is neither River or Lake any where in that Part of the Country, and it is above 6 Miles from the Sea. There are very near it ſeveral much lower Valleys, in which there is no Appearance of Water, unleſs a little Rain-Water collected in a Pit, in the Fiſſure of a Rock, or the like.

An Account of the Eruption of Veſuvius *in* May 1737, *by* Nicolas-Michael d'Aragona, *Prince of* Caſſano, *and F. R. S. Tranſlated from the* Italian, *by* T. S. *M.D. F.R.S.* No. 455. *p.* 237. Nov. *&c.* 1739.

VIII. Mount *Veſuvius* is generally eſteemed about 7 Miles diſtant from *Naples*. It riſes in the Middle of a large Plain, which ſurrounds it on every Side. It is better than 4 Miles from the Sea, and the Foot of the Mountain is ſeen to begin from the Sea-Coaſt, which growing gradually higher, reaches the firſt Plain, to which one can eaſily ride on Horſeback. The Figure of the Plain is almoſt circular, being about 5 Miles in Diameter, and half a Mile perpendicular Height above the Level of the Sea. This is the Baſis of the Mountain, out of which ariſes another, called by the People of the Country *Montevecchio*, whoſe perpendicular Height is about 400 Paces, and it's Top little leſs than 2 Miles in Circumference, of an irregular Figure. The ſaid Top, before the Year 1631, was of the Form of a Baſon, but all ſurrounded with aged Oaks, and vaſtly large Cheſtnut-Trees, whoſe Fruit afforded Food ſufficient for a Number of Cattle that fed thereon. In the Bottom a Cavern was obſerved, into which People deſcended above 200 Paces, by difficult and interrupted Paths; and this Opening was looked upon as the ancient Mouth, which for a long Space of Time had conſtantly caſt up great Quantities of bituminous Matter, and had at the ſame Time burnt up a conſiderable Part of the neighbouring Country, cultivated by the Inhabitants round the Hill.

Concerning the Eruptions that have happened heretofore, they are very numerous, as well ancient as modern.

Of the firſt, ſeveral are taken Notice of by *Beroſus Chaldæus*, *Polybius*, *Strabo* in the Time of *Auguſtus*, *Diodorus*, and *Vitruvius*; and

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in *Trajan*'s Reign the Name of the Mountain became more famous by the Death of *Pliny*. From that Time forward, it is not doubted, that the Eruptions were leſs frequent down to the Year 1139; when, after a conſiderable Eruption, it began to take Reſt, and continued quiet ſomewhat leſs than 5 Centuries; ſo that the horrid Remembrance of the paſt Ruins was pretty well obliterated out of the Minds of the neighbouring Inhabitants; who, vainly flattering themſelves with Hopes, that the inflammable Matter was ſpent, planted the whole Diſtrict round the Mountain, which, by it's Fertility, became the Delight of theſe Parts. But, in Proceſs in Time, they found themſelves deceived and fruſtrated in their Expectations: For in the Year 1631, during ſix Months Space, continual Rumblings were heard, and Shocks of Earthquakes felt: And afterwards, in *Dec.* a dreadful fiery Eruption happened, which firſt blew up Part of the Mountain into the Air, in a terrible Manner, and then vomited out Water, Aſhes, Stones, and Fire; inundating almoſt the whole Country around to the Sea, and for above 7 Miles in Breadth, with the irreparable Loſs of more than 4000 People. After which the Mountain became ſilent, and remained conſiderably diminiſhed in it's Height, from what it had been before.

It continued quiet for 29 Years, but having rekindled in 1660, it's Fire filled the whole Capacity of the immenſe Hollow, which remained ſince the Year 1631; whence, after ſeveral leſſer Eruptions, a new Mountain appeared in 1685.

In 1707, not only the Inhabitants of the Neighbourhood, but alſo the whole City of *Naples*, were put into great Terror, and not without Reaſon, by the Apprehenſions of a Renewal of the diſmal Tragedy of 1631, upon Account of the frequent Noiſe and Shocks, the Fire ſeen on the Top of the Mountain, with a vaſt Quantity of Aſhes, which iſſuing out with Impetuoſity, were diſperſed all over our Hemiſphere, and darkened the Light of the Sun for one whole Day's Space. Theſe were all manifeſt Signs of the impending Deſolation; and yet (whether by a Miracle of our particular Protector St *Januarius*, as ſome were of Opinion, or by natural Cauſes) this dreadful Day, which had portended ſo much Miſchief, was beyond Expectation, and to our great Aſtoniſhment, followed by another as pleaſant as could be deſired: For the Air was quite ſerene, and clear of the Aſhes; and on the Mountain there was no other Appearance but that of a little Smoke.

In the Year 1724, the Quantity of Aſhes and Stones, thrown from the Top of the Mountain, were ſo heaped from the Bottom up to the Edge of the old Mountain, that the whole Space from the old Hill to the new, appeared but one continued Mountain.

In 1730 there was another Eruption of *Veſuvius*, which, though very inconſiderable in reſpect of the laſt, yet was the Occaſion of much Fear.

This preſent Year 1737, to the Month of *May*, the Mountain was never quiet: Sometimes emitting great Quantities of Smoak, at other Times

Times red-hot Stones; which, for want of a ſufficient impelling Force, fell on the ſame Mountain. But in order to a clear Idea of all the Circumſtances preſaging the impending Eruption, it is requiſite to know, that in the Beginning of *May*, a Smoak only was ſeen to iſſue from the open Mouth at the Top; and from the 16th to the 19th, ſubterraneous rumbling Noiſes were heard.

On the 19th, Fire was ſeen to burſt out in thick black Clouds; and the ſame Day there were ſeveral loud Reports, returning quicker towards the Evening: And ſtill more on *Sunday* Night, when there conconſtantly appeared a very great Smoak mixed with Aſhes and Stones; and the Neighbourhood felt ſome Shocks, like thoſe of a weak Earthquake.

On *Monday* the 20th, at 13^h, the Mountain made ſo loud an Exploſion, that the Shock was ſtrongly felt not only in the Neighbourhood, but alſo in the Cities twelve Miles round. Black Smoak, intermixed with Aſhes, was ſeen ſuddenly to riſe in vaſt curling Globes, which ſpread wider as it moved farther from the Baſon. The Exploſions continued very loud and frequent all this Day, ſhooting up very large Stones through the thick Smoak and Aſhes, about a Mile high, to the Horror of the Beholders, and Danger of all the neighbouring Buildings.

At 24^h, amidſt the Noiſe, and dreadful Shocks, the Mountain burſt on the firſt Plain, a Mile diſtant obliquely from the Summit, and there iſſued from the new Opening a vaſt large Torrent of Fire; whence, by the Quantity of Fire inceſſantly thrown up into the Air, at a Diſtance all the South Side of the Mountain ſeemed in a Flame. The liquid Torrent flowed out of the new Vent, rolling along the Plain underneath, which is above a Mile long, and near 4 Miles broad; and in it's Way it ſpread very ſpeedily near a Mile wide; and by the fourth Hour of the Night it reached the End of the Plain, and to the Foot of the low Hills ſituated to the South. But as theſe Hills are rugged with Rocks, the greateſt Part of the Torrent ran down the Declivities between theſe Rocks, and into two Valleys; falling ſucceſſively into the other Plain, which forms the Baſis of the Mountain; and after uniting there, it divided into four leſſer Torrents, one of which ſtopped in the Middle of the Road, 1 ½ Mile diſtant from the *Torre del Greco.* The ſecond flowed into a large Valley. The third ended under the *Torre del Greco*, near the Sea; and the fourth at a ſmall Diſtance from the new Mouth.

The Torrent which flowed into the Valley, ran as far as between the Church of the *Carmelites*, and that of *the Souls of Purgatory*, by the 8th Hour on *Tueſday*. The Matter of the Torrent ran like melted Lead: In 8 Hours it made 4 Miles; and, conſequently, it flowed ½ a Mile in an Hour: A new and remarkable Circumſtance of this Eruption, ſeeing *Buliſone* thought it very ſtrange, that in the Eruption of 1698, the Torrent had advanced 60 Paces in an Hour; whence he infers, that

ſuch

ſuch great Swiftneſs proceeded from a greater Degree of Liquation of the Matter. The Trees, which the Torrent light on in it's Way, upon the firſt Touch took Fire, and fell under the Weight of the Matter.

The Torrent which ran behind the Convent of the *Carmelites*, after ſetting the little Door of the Church on Fire, entered not only therein, but alſo through the Windows of the Veſtry, and into two other Chambers. In the Refectory, it burnt the Windows; and, what is ſurpriſing, the Glaſs Veſſels, that ſtood on the Tables, were melted into a Paſte by the violent Heat of the Fire. Sixteen Days afterwards, the Matter continued hot, and was very hard, but it was broke by repeated Blows.

A Piece of Glaſs faſtened on the Top of a Pole (and thruſt into this Matter) was in 4 Minutes reduced to a Paſte. Under the Maſs of the Torrent were heard frequent Reports, which made the Church ſhake, as if by an Earthquake. Along the whole Surface of the Torrent, there appeared ſmall Fiſſures, out of which iſſued Smoak, that ſtunk of Brimſtone mixed with Sea-Water; yet theſe Exhalations are not poiſonous, but rather a Remedy for ſome Diſeaſes. The Stones round about theſe Fiſſures were obſerved to be covered with ſublimed Salts, the Nature of which I ſhall explain hereafter.

Iron, thruſt into theſe Fiſſures, was taken out moiſt; but upon thruſting in Paper, it was not moiſtened, but rather ſomewhat hardened.

At the ſame Time when the new Mouth opened, that on the Summit of the Mountain vomited a vaſt Quantity of burning Matter, which, dividing into Torrents, and ſmall Streams, ran partly towards the *Salvadore*, and partly towards *Ottajano*; and at the ſame Time that this Matter iſſued out, red-hot Stones were ſeen to be caſt out of the Mouth, in the Midſt of black Smoak, frequent Flaſhes of Lightning and Thunder, all produced by the ſame Matter.

Theſe impetuous Expulſions of Fire continued till *Tueſday*, when the Eruption of the melted Matter, the Flaſhes, and thundering Noiſe, ceaſed; but a ſtrong S W Wind ariſing, the Aſhes were carried in great Quantities to the utmoſt Boundaries of the Kingdom; in ſome Places very fine, in others as coarſe as *Iſchian* Sand: And in the Neighbourhood they not only felt this plentiful Shower of Aſhes, but likewiſe Pieces of Pumice-Stones, and other large Stones.

Tueſday Night the Fury of the Mountain began to abate, ſo that on *Sunday* there was ſcarce any Flame ſeen to break out of the upper Mouth; and on *Monday* but little Smoak and Aſhes. This Day it began to rain plentifully, which continued to *Tueſday*, and afterwards for many Days: A Circumſtance which has conſtantly happened after the Eruptions of Times paſt.

The Damages done in the Neighbourhood by this Eruption of Fire and Aſhes, are incredible. At *Ottajano*, ſituated between 4 ½ and 5

Miles from *Veſuvius*, the Aſhes on the Ground were four Palms high. All the Trees were burnt (or blaſted) the People terribly affrighted, and many Houſes cruſhed by the Weight of the Aſhes and Stones that fell.

After the Deſcription of this fiery Eruption, the Academy of Sciences [at *Naples*] thought proper to make an accurate Analyſis of the Matter, and of the Salts, that were collected in great Plenty near the above-mentioned Fiſſures; and, towards the Diſcovery of the Truth, they effectually made the following Experiments:

Exp. 1. Some of the Stones of *Veſuvius* being pounded ſmall, and the Loadſtone applied to the Powder, ſome few Particles were attracted by it; and the ſame Powder, put into *Aqua fortis*, cauſed a ſenſible Effervescence; whence it certainly contains no ſmall Quantity of Iron: Which was alſo found upon Trial in another Eruption by *Tomaſo Cornelio*. But for the greater Elucidation of Truth, one of theſe Stones being applied to the magnetic Needle, it turned to the Stone; and then carrying it round to the oppoſite End of the Needle, it immediately turned from it, in the ſame Manner as if Iron was applied near the Compaſs.

Exp. 2. The Stones are not all of the ſame Denſity or Colour, but various, and of different Ponderoſity. Some are compoſed of real Talck, others full of Marcaſites: Some are almoſt all ſulphureous, others nitroſe; ſome of a grey Colour, others red.

Exp. 3. The Matter of the Current is ſpongy at Top, but very denſe towards the Bottom; which is a Proof of the Fuſibility thereof, whereby the heavier Bodies ſubſided, and the lighter remained at Top.

Exp. 4. After growing hard, it retained Part of the Heat above a Month, though unequally: For in the inward Parts, where the Air had not free Acceſs, and the Matter was more compact, the Heat was much ſtronger than towards the Surface.

Exp. 5. Twenty Days after the Eruption, in divers Parts of the Mountain, from the Bottom to the Top, there were ſeen to ariſe many pernicious Damps, [*Mofete*] eſpecially from the Cavities, and the Fiſſures of former Torrents; as alſo on the Plain: But none were obſerved in the Matter of this laſt Eruption. They iſſued out of the Fiſſures under the Appearance of a cold Wind, and roſe about 3 Palms high; then they moved along the Surface of the Ground, and, after a Progreſs of ſome Paces, diſappeared. Animals, which happened to graze where theſe paſſed, were all killed thereby; and likewiſe a *Teresian* Friar, who inadvertently breathed the Vapour of one of theſe Damps.

Exp. 6. Having placed the Barometer in the Vapour, it underwent no Change, but the Thermometer fell ſomewhat more or leſs. A lighted Torch, thruſt into them at two Palms from the Ground, was ſoon extinguiſhed by the Action of the Damp.

Exp. 7.

Exp. 7. Theſe Damps grew gradually weaker in their pernicious Effects for above 3 Months, even to the ſubſequent Autumn, as has been generally found in other former Eruptions, or when they happened to iſſue out of their Vents.

Exp. 8. Concerning the Salts which are generated in Abundance in *Veſuvius*, I have, by Order of the Academy, examined them by accurate Experiments. My Intention was to know, if beſides Salt Ammoniac, there were alſo Sea-Salt, Vitriol, Nitre, or any other Salt. I thought there was no better Way of proceeding in this Inquiry, than by Cryſtallization; becauſe it is univerſally allowed, that Salts in cryſtallizing conſtantly retain one certain and determinate Figure; Sea-Salt concreting into Cubes, vitriolic Salt into rhomboidal Parallelepipeds, Alom into Octædrons, and Nitre into rectangular Priſms on hexagonal Baſes. I imagined, that if the Salt of *Veſuvius* happened to contain any Particles of the Salts above-mentioned, it would diſcover them after Cryſtallization. This Way of reaſoning was confirmed by Experiment: For the *Veſuvian* Salt, in cryſtallizing, left on the Sides of the Veſſels ſmall Parcels of cryſtallized Salts, which, obſerved through a Microſcope, reſembled a Tree with it's Branches, on the Ends of which there appeared ſeveral Pyramids of an irregular Figure, but very ſharp-pointed; and between the Branches there were interſperſed in ſome Places a Group of Priſms, in others ſome ſmall Cubes: Whence I inferred, that the aforeſaid Salt was ammoniacal, and indeed a genuine and efficacious Salt-Ammoniac, with inſenſible Portions of Nitre and Sea-Salt. Which coincides with the Sentiments of the Royal Academy of *Paris* in 1705; with thoſe of *Thomas Cornelius* in his *Progymnaſma de Senſibus*; of *Dominicus Gulielmini* in his Treatiſe *de Salibus*; of Dr *Boerhaave* in his Chemiſtry, and many other Writers.

Exp. 9. In order to be convinced whether this Salt was really ammoniacal, and of the Nature of neutral Salts, I mixed it with Spirit of Vitriol, and Spirit of Salt, without producing the leaſt Fermentation. I afterwards put ſome of it into Oil of Tartar *per deliquium*, and could not perceive any Ebullition; wherefore it is to be ranked among the neutral Salts.

Exp. 10. Thrown upon red Coals, it did not crepitate like Sea-Salt, but it boiled and ſwelled, and after evaporating, it dried up.

Exp. 11. It is of a very pungent Taſte, ſtrongly pricking the Tongue, and of a bituminous Smell of Brimſtone, which occaſions a violent Head-ach by it's volatile Texture.

Exp. 12. The Salts taken from different Stones are not all of the ſame Weight or Colour: For ſome are yellow and unctuous, as if rubbed all round with *Petrolæum*: Others are very white, others blackiſh, and others of other Colours, according to the Stones they adhered to.

Exp. 13. I have likewiſe found by Experience, that the Salt Ammoniac of *Veſuvius* is much more efficacious than any other Salt known at this Day, in cooling Liquors. Upon diſſolving ſome of it in Water,

it makes the Water ſo cold, that the Sides of the Veſſel which contains it, can hardly be touched without Uneaſineſs, through the exceſſive Cold.

Exp. 14. M. *Geoffroy* looks on it as a ſingular Power of common Salt Ammoniac, that being mixed with a certain Quantity of Water, it rendered the Water ſo cold, that it made the Spirit of his Thermometer, 18 Inches high, fall 33 Lines. But I have ſhewn to ſeveral Perſons, that the *Veſuvian* Salt makes the Liquor of a Thermometer, like his, fall 4 ½ Inches; which is equal to 54 Lines. Wherefore the Efficacy of this Salt, in cauſing the Fall of the Liquor, exceeds the Efficacy of common Salt Ammoniac by 21 Lines.

Exp. 15. If round a Veſſel full of Water cooled with Snow, there be put ſome of the Salt of *Veſuvius*, the Water freezes and grows hard in a very little Time.

Exp. 16. If you put a good Quantity of the Salt of *Veſuvius* into Snow ſet round a [Glaſs] Veſſel full of Water, and then ſtir the Veſſel, the Water contained therein becomes unfit to drink, having acquired a very diſagreeable, acrid, ſulphureous Taſte; a manifeſt Sign, that the Salt is divided into ſmall Particles, which paſſing through the inſenſible Pores of the Glaſs, enter into and mix with the Water.

Exp. 17. Of all Kinds of Salts, this diſſolves in the greateſt Quantity in Water; and perhaps the greater or leſſer Diſſolubility of a Salt in Water, will be [found] proportional to it's greater or leſſer Effect in cooling Water.

Exp. 18. Being put into Brandy, or Oil, beſides that very little of it is diſſolved, it occaſions no Deſcent of the Liquor in the Thermometer.

Exp. 19. Being mixed with Blood lately drawn from the Vein of a Man, but coagulated after ſettling, the Blood was thereby diſſolved, and continued in that State for the Space of 24 Hours.

Exp. 20. A Solution [of this Salt] being injected into the Vein of a Dog, firſt occaſioned Tremors, then univerſal Convulſions, and laſtly Death: And 4 Hours afterwards, having opened the Dog, the Blood, which ſhould have been coagulated, was found fluid, both in the Trunks of the Veins, and at the Ends of the Arteries.

Exp. 21. It has all the Properties of Salt Ammoniac to that Degree, that upon ſubſtituting this *Veſuvian* Salt, inſtead of common Salt Ammoniac, the ſtrongeſt Sort of *Aqua Regia* may be had for diſſolving Gold: Which Experiment was made with Succeſs by M. *Lemery*, in the Academy of *France*.

Exp. 22. If a Lump of the mineral Matter be reduced to a fine Powder, and attentively viewed through a Microſcope, it appears very like the Sand of *Iſchia*, and is very proper for Writing-Sand: Whence I conjecture, that that Sand is nothing elſe, but the [ſame] Matter for a long Time comminuted by the Action of the Sea.

Exp. 23.

Exp. 23. In ſome of the Stones there appear ſome few Veins of Gold, in others of Silver, but inſenſible; and in others, which are very heavy, there is ſome Antimony.

Exp. 24. A great Diſpute aroſe in the Academy on the Riſe of the [*Mofete*] Damps; for what Reaſon theſe ſhould be ſeen only in the old *Strata* of the mineral Subſtances, and not in the new, where by the Action of the Fire they ought to iſſue: Which *Phænomenon*, if I am not miſtaken, may be accounted for in this Manner: As the cooling of the burning Matter begun at the Surface, we may think, that the more ſubtle heterogeneous Particles, upon the cloſing of the Pores at the Surface, remained in Quantities buried in the lower Parts of the Matter; which, in Proceſs of Time, becoming acutangular, and of deleterious Figures, yet cannot offend while impriſoned: But in new Eruptions, wherein the Shocks given to the Matter produce many Fiſſures, the Damps, meeting with leſs Reſiſtance there, iſſue forth: As when the Air is a long Time pent up in ſome Hollow, upon giving it Vent, it generally comes out in a pernicious Vapour.

Exp. 25. It was obſerved, that the greateſt Shocks happened to ſuch Things as ſtood expoſed to the *Volcano*; but that thoſe Things which were not thus expoſed to it, received but faint Shocks: A manifeſt Sign, that the Vibration of the Air had a great Share in the Shocks of the Earth: Which Circumſtance is taken Notice of by *Borelli* with reſpect to Mount *Ætna*.

IX. I was lodged for ſome Time at *Chaja*, and afterwards at *Fontina Medina*, in the Face of this ſurpriſing Neighbour [Mount *Veſuvius*] which from thence doth not appear to be above 2 or 3 Miles diſtant.

An Account of the Eruption of Mount Veſuvius, May 18, *and the following Days*, 1737, *N. S. by an* Engliſh *Gentleman at* Naples *to his Friend in* London. Ibid. *p.* 252. *Dated* Naples, Aug. 30, 1737, *N. S.*

It gave us Strangers conſtant Entertainment, by ſhewing us what it could do, as well as great Satisfaction to the People of *Naples*, who, whilſt it continues burning more or leſs without ceaſing, are under no Apprehenſion (and I believe with good Reaſon) of an Earthquake: But we little thought of being invited to a Sight, *Quod nunquam vidimus, & nunquam videbimus*; for by all the Accounts of the Living, there has not been any Eruption in their Remembrance near ſo violent, nor ſo furious; and Authors mention none to this Degree later than above 100 Years ago. On *Friday*, *May* 17, 1737, *N. S.* I obſerved, as far as I could ſee round, that the Mountain was covered with white Aſhes a great Way down, as it hath been with Snow in the Winter, which I could not find any Body here, or at *Barra* near *Portiche*, take any Notice of; though I ſhould be apt to think for the future, that it might be a Fore-runner; for I had never ſeen any Thing like it. *Pliny* obſerves in theſe Words, *Præceſſerat per multos dies terræmotus minus formidoloſus, qui Campaniæ non ſolum caſtella, verum etiam oppida vexare ſolitus.* (Plin. *Lib.* vi. *Ep.* 20.) Other Authors ſay the contrary, though it may very likely be ſo, round and near the Foot of the Mountain; but this Time I have not found any Body ſenſible of it here; but it is certainly true, that our Windows and Doors ſhook all the Time of the Violence

Violence of the Eruption, which I take to be from the very great Concuſſion of the Air upon the violent Exploſions: A Door which had a Latch, to my great Suprize, opened often of itſelf. I cannot conceive a tremulous Motion of the Earth from the Mountain hither, unleſs it were thoroughly cavernous from thence, which the People here deny, and particularly the Author *Paragallo*.

On *Saturday* Night (*May* 18) this great *Phænomenon* began, and increaſed ſo much on *Sunday*, that it brought half the People out to gaze at it, with great Variety (no Doubt) of Paſſions and Ratiocinations. There were certainly, amongſt ſome, great Apprehenſions, by their being employed in Proceſſions, viſiting their Churches, and expoſing their Images of the Virgin *Mary*; but I looked upon them as very ungrateful to their great Patron [St *Januarius*] in having any Dread, when they even boaſt, that he has never failed delivering them from their greateſt Diſtreſſes; but by the terrible Havock I have obſerved in their Country, as well as what has been made by this laſt Eruption, I find he hath always left them in the Lurch: However, as I had not loſt a Grain of the Faith I ever had in that Saint,

I very boldly ſet out on *Monday* about two Hours before Sun-ſet. It was a melancholy Sight, to ſee the Road full of Numbers of poor Wretches, flying as from *Sodom*. I ſtopped on the Way, to obſerve the vaſt Clouds of Smoak, which was thrown up in a prodigious Column, to an Height not to be gueſſed at, which, by it's gentle Waving and Undulation, was a moſt beautiful Sight; and when it had mounted ſo high, that it had loſt the Force of the Protruſion, it was carried by the Wind a vaſt Way; but not too far for one to obſerve how it's Rolls began to break, and, being diſperſed and expanded, covered the Country underneath with Aſhes and Darkneſs. There were many great Flaſhes of Lightning darted through this Pillar of Smoak, and frequent Diſcharges as of Cannon or Bombs, which were followed by falling Stars, ſuch as we ſee from well-made Rockets. We turned off out of *Portiche*, to gain the North Side of the Mountain, as far as we could, in Chaiſes, till we were forced to get upon Aſſes or Mules.

It was now growing dark, and the Fire began to be viſible, which it was not in the Day-time, the Sun bearing no Rival. The prodigious *Bouïllon* of Fire, and the extreme Force it was expelled with, as well as the vaſt Height it was carried up to, are not to be deſcribed or gueſſed at. If I ſhould imagine an hundred *Stentors* or *Polyphemus*'s, with as many of *Phalaris*'s Bulls roaring all together, they could not bellow more terribly. But to have a truer Idea of this Scene, you muſt look into *Burnet*'s moſt beautiful Painting of the general Conflagration. As we looked round this Northern Side, the whole Country appeared as if over-run by *Samſon*'s Foxes.

In a little Time, by the Light of the Mountain, (though that was much obſcured by the Clouds and Pillar of Smoak) and the Help of our Torches, we ſcrambled over very rough Roads, till we got within a Quarter

a Quarter of a Mile of the great *Lava* or Current: But then I ordered an Halt; for indeed the Scene on all Sides became ſo ſtupendous and terrible, that I thought I ſhould make a very fooliſh Figure, if any Misfortune ſhould happen to us.

We returned to *Portiche*, where we ſupped, and got home, much fatigued, by 2 in the Morning. The Fury of this Eruption was at it's Height this Night, as to burning; but the next Day (*Tueſday*) the Columns and *Bouïllons* of Smoak were as great, and thrown out with as much Violence, which, as the Wind ſat, carried it's Deſtruction, not of the large maſſy metallic Bodies, but of infinite Quantities of Aſhes and Cinders, all that Day, and Part of the Night. Through the Columns of Smoak was a continued Lightning, the moſt beautiful Sight imaginable.

The following Day (*Wedneſday*) we ſet out again to view the Weſt Side of the Mountain at *Torre del Grejo*, 8 Miles from hence; where we heard, that the great *Lava* had ſtopped at the Church of the *Carmelites*, but not without carrying Part of it away: Yet the People were ſuperſtitious enough to think this Stop miraculous; though it made a great Breach on one Side, broke down and quite demoliſhed their Sacriſty, beſides cracking the Roof. This *Lava* had from the Declivity taken the Water-courſe, which was the Preſervation of the Country from being drowned (and the People had beſt look to themſelves, unleſs they make another). This Hollow, which was for ſome Miles between 30 and 40 Feet deep, and as many wide, was not only filled up, but the Matter roſe as many Feet above the Surface of the Land about it: We walked to view it on one Side, but the Heat was ſo intenſe, and the ſulphureous Stench ſo ſuffocating, that we were obliged to keep at a good Diſtance; and I was well informed by ſeveral, that it continued very hot a Month or 5 Weeks after; ſo long in cooling is that great Quantity of bituminous and metallic Matter, with which this *Vomes* is loaded.

As the Fury of the Expulſion and Exploſion was much abated on *Tueſday* Morning, the Stop here was about four that Day in the Afternoon; which might be the more eaſily conceived, when no more of this vaſt metallic Matter was diſcharged, and the Motion of all the reſt was relented, for want of more Protruſion, and the Bitumen growing a little cooler. As this Stop was made at the Church, Part of the *Lava* took a Turn into the great large Road to *Salerno*, to a great Height; which Part is choaked up for ever, the Expence being immenſe to remove it. *N. B. Giulio Ceſare Reputio*, one of the Authors who deſcribes the Eruption in 1631, ſays, one of the maſſy metallic Bodies was in his Time weighed, and the Weight amounted to 500 *Cantaras*, a *Cantara* being nearly 200 Weight. They have ſince made the Road paſſable, by laying Earth upon the *Lava*, and ſo have added to the Hills of their Country. There are ſome who pretend to ſay, that the Matter diſcharged this Time in the different Currents or *Lava*'s

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round about, would make a Mountain as big as their Sire. The *Carmelites* here ſoon fled, and were not come back ten Days afterwards, when we returned that Way, to viſit the S E Side, to view the great Devaſtation which was made about *Ottajano*, 18 Miles from hence; for though the great Diſcharge of the metallic Body ceaſed on *Tueſday*, a vaſt Deſtruction of the Country followed for a long Time after; for as the Force of the Exploſion was very great, it continued to throw out vaſt Showers of Cinders and Aſhes. The Lands indeed, where the *Lava's* fall, are annihilated to the Owners; but the other Materials deſtroy all the Fruit and Produce of the Earth where they fall, which doth not recover for a long Time; and in this unhappy Diſtrict, his Majeſty hath, with great Goodneſs, taken off all Taxes for 10 Years.

As we turned on the Left from *Torre del Grejo* towards *Ottajano*, we paſſed all the Way through their *Maſſerias* [Farms]; and the Mountain, having the Weather-gage of us for 3 or 4 Miles, rained Aſhes plentifully upon us, and we loſt our Smell of every Thing but Brimſtone. All the Trees, Vines, and Hedges, bent under the Weight of theſe Aſhes, ſeveral Arms, and even Bodies of Trees, were broken with the Weight; ſo that in ſome narrow Roads we had Difficulty to paſs. Within a Mile or two of the Prince of *Ottajano*'s Palace (a very honeſt worthy Gentleman, who has ſuffered a Loſs of above 100,000 Ducats, or 50,000 *l.* ſome ſay more) one can ſcarce frame to one's ſelf a Sight of greater Deſolation; ten ſucceſſive Northern Winters could not have left it in a worſe Condition: Not a Leaf on a Tree, Vine, or Hedge, to be ſeen all the Way we went, and ſome Miles farther, as we were informed: Here, and at the Town, they had a new Earth, about 2 Feet deep, ſome ſaid more, by the Account of the miſerable Inhabitants, who were a diſmal Spectacle, though they had recovered their Fright, and ſeemed to be got into a new Heaven. The Storm fell ſo thick and heavy for that Time, that they almoſt all fled, and many Houſes were beaten down. In one Convent, two or three Nuns were buried in the Ruins. At *Somma*, on the N E Side, it has made great Havock; a Monaſtery of Nuns was deſtroyed. After a long Day's Work, we returned at ſix o'Clock.

The Earth of this Country is, no Doubt, greatly compounded of Sulphur and Nitre, from whence Dr *Burnet* hath fixed it for the Beginning of the general Conflagration; though he has, out of a particular Spite to the People of *Rome*, laid the Commencement of it there. The great Quantities of Sulphur and Nitre are, to be ſure, the Operators of theſe great Exploſions, Lightnings, Bombs, Bellowings, and Expulſions of all this Matter; and Nature can certainly make much ſtronger and more elaſtic Gunpowder, than Mankind; elſe thoſe great maſſy Bodies of Metals could not be thrown up with that vaſt Force, to that great Height. The Bodies are compounded of various Metals, and, as it were, incorporated with the Bitumen: They pretend to find ſome Silver, but I queſtion whether the Gains will pay the Coſts.

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They have ſpoken of the *Lava*'s, as if their Motion was quick; but I obſerved otherwiſe, that it is ſlow, and the Progreſſion rather like a vermicular one: And beſides truſting to my Sight, I am rather apt to think it muſt be ſo, becauſe, though in a great Declivity, theſe great Maſſes muſt be much retarded in their Motion, by their large unequal Points or Angles; beſides, the Glewyneſs of the Bitumen as it cooled, would very much impede a quick Motion; which Bitumen is that Matter that flames, ſmokes, and is ſo very ſuffocating.

By ſome of the Ancients, theſe burning Mountains have been looked upon as Divinities, and that they lived there: To confirm which, there was a Marble found at *Capua* (as *Paragallo* affirms) with this Inſcription, *Jovi Veſuvio ſacrum D. D.* The *Greeks* made uſe of them in their Mythology, by clapping the Rebel Giants under them.

I muſt not conclude without ſaying ſomething of the *Mofete*, upon which much have been written, particularly by *Leonardo de Capua*; but all might be reduced into a narrow Compaſs. I mention it now, becauſe it hath given great Terror to the Neighbourhood of this Mountain; four or five Perſons near *Torre del Grejo*, *Portiche*, and ſome other Place, having been killed by going into their Caves or Cellars: And it is particularly remarked to have been thus deſtructive all round the Hill, after the great Eruptions; upon which the great Agitation and Rarefaction of this inflammable Earth, compoſed of ſuch active Particles, even *Sal Ammoniac*, muſt ſend out vaſt and ſtrong *Effluvia*, (or what in ſuch cloſe Places may properly be termed Exſudations) pernicious, no Doubt, when confined under-ground, and hindered from expanding and mixing with freſh Air: And, no Doubt, all round the Mountain they abound; but the open Air is a Specific againſt their ill Effects; as we ſee it is an immediate Cure to the poor Dog at the *Grotto del Cane*, and not any particular Quality of the neighbouring Lake, which throwing him into, I ſhould rather think, would kill him, till he had recovered his Reſpiration and Spirits. *Virgil*, *Æn.* VII. 84, mentions theſe Damps:

——————*Nemorum quæ maxima ſacro*
Fonte ſonat, ſævamque exhalat opaca mephitim.

And to theſe Stenches *Perſius*, Satire III. l. 99, reſembles the Scent of a ſtinking Breath:

Gutture ſulphureas lente exhalante mephites.

The following Authors have given very ample Accounts of the Eruption of Mount *Veſuvius*, on *Dec.* 16, 1631.

Giulio Ceſare Braccini; Dell' Incendio fattoſi nel *Veſuvio*, a 16 *Dec.* 1631, *Neapoli*, 1632, 4^to^.

Don *Juan de Quinones*; El Monte *Veſuvio*, *Madrid*, 1632, 4^to.

Julius Cæſar Recupitus; de Incendio *Veſuviano* Nuncius, *Neapol.* 1632-3, 8^vo.

Joh. Bapt. Muſculus; de Incendio *Veſuvii*. Neapol. 1633, 4^to.

Gaſpar Paragallo; Ragionamento de' *Tremuoti*. Neapoli, 1689, 4^to.

The Hiſtory of an Earthquake, which ſhook Apulia, *and almoſt the whole Kingdom of* Naples, *in* 1731, *by* Nicholas Cyrillus, Pr. Prof. Med. in Reg. Univerſitate Neapol. *and F. R. S.* No. 428. *p.* 79. Apr. *&c.* 1733.

X. *March* 9, 1730-1, *O. S.* 4^h *a. m.* an Earthquake ſhook the whole Kingdom of *Naples*, but chiefly *Apulia*. In it's Duration, all the Appearances mentioned by the Ancients were obſerved. Firſt a Trembling, then a Shaking, and at laſt an Inclination, or Nutation of the Earth, like the Motion of a Ship. Theſe various Motions ſucceeded each other for the Space of 3′, and ſome Seconds. It was not obſerved by my Friend, whether the Nutations and Oſcillations of the Earth were made according to the parallel Circles of the Earth, according to the Obſervation of modern Philoſophers, who endeavour thereby to confirm the diurnal Motion of the Earth. But I myſelf and others have obſerved it to be ſo, not only in this, but alſo in former Earthquakes.

The Air at that Time was heavy with thick, low, hanging Clouds, which were afterwards diſſipated by a gentle N E Wind. The next Day the Sun ſhone faintly, as if it were covered by very thin Clouds; but no ſuch Clouds were diſtinguiſhable in the Sky. This *Phænomenon* has alſo been obſerved in ſubſequent ſtrong Earthquakes. The Fiſhermen who were then at their Work on the Coaſt, obſerved the Sea to ſwell on a ſudden, and rode out the Storm coming from the Northward, without any Wind; but thought themſelves in Danger of Shipwreck.

The next Day, *March* 10, 8^h *a. m.* there happened a new but ſhorter and weaker Earthquake, in the ſame Province; not ſo weak, however, but that it was perceived here at *Naples*. This was preceded by a certain flaſhing or ſhort Coruſcation about the Mountain *Garganus*, which turning to Smoak or Fog, gradually diſappeared. In the Country about *Foggia*, this Earthquake, and others alſo in *April*, *Oct.* and *Nov.* were generally preceded by a ſtrong N E Wind, though the Air was ſometimes quite ſtill.

There was no ſmall Ruin of Buildings, and Deſtruction of Perſons cruſhed by them; for the Dead were reckoned to be about 600.

The Centre of theſe Shocks ſeemed to be at *Foggia*: For there were the moſt cruel Motions and Ruins; and from thence they diminiſhed gradually to Places more remote; ſo that one might ſay, that the Propagation of this Motion was ſucceſſively diminiſhed (only ſo far as it was altered by the various Solidity and Interruption of the interjacent Earth) in a duplicate *Ratio* of the Diſtances: According to the common Laws in other Sorts of Motions.

The ſame was obſerved alſo in the Oſcillations of Pendulums by two careful Obſervers. For Pendulums of a Palm in Length, at *Aſculum* and *Iuvenatium*, being applied to a graduated Semicircle, and moving

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in the Shocks, ſwung more or fewer Degrees from the Centre of Oſcillation, according to their leſs or greater Diſtance from *Foggia*: For the greater Number of theſe Degrees at *Aſculum*, which is nearer; and the leſſer at *Iuvenatium*, which is farther, anſwered almoſt to the duplicate *Ratio* of the Diſtances of theſe Places from the Centre of the Earthquake. And hence alſo it came to paſs, that when the Earth ſhook but little at *Foggia*, the Pendulum vibrated but little at *Foggia*, and was obſerved to ſtand perfectly ſtill at *Iuvenatium*.

In all the Shocks, which happened for almoſt a whole Year together, it was conſtantly obſerved in the open Fields, that they were preceded by a Noiſe and horrid Rumbling in the Air. Thus we read in *Pliny*, *Lib.* ii. *C.* 80, that terrible Noiſes, Groans, and ſometimes Sounds, like human Cries preceded them. This Noiſe in the Air was ſpread in a contrary Determination: So that as the Parts of the Earth were ſhaken, with a Motion communicated from the Centre to the ſurrounding Places; ſo, on the contrary, the Motion of the Air was not obſcurely propagated from the Circumference toward the Centre. This *Phænomenon* has afforded no ſmall Matter of Diſpute among Philoſophers; but I do not think myſelf concerned in it. I ſhall only obſerve, that this differs from *Ariſtotle*'s Opinion, in his Meteors, that an external Wind was neceſſary to form an Earthquake: So that, according to him, an Earthquake on the Coaſt of *Achaia* was cauſed by a Conflict of the N. and S. Winds. Some indeed have ſuſpected, that ſlight Earthquakes, which were formed after ſtrong E. Winds, might ariſe from a Retardation of the diurnal Motion of the Earth, at leaſt in that Track where the Wind blew.

This alſo is obſervable with regard to our Earthquake, that near the Farm of the *Carthuſians* called *Tre Santi* (of which the Houſe was levelled with the Ground by the firſt Earthquake in *March*) in the Place where the Bed of the Brook called *Fontana del Peſce* is moſt depreſſed, there burſt out a new Source of copious, turbid, warm Water. This indeed is not new or unknown to the Ancients: For we learn from their Records, that Waters burſt out from the opening Body of the Earth, juſt as the Water enters a Ship through it's Fiſſures: Nay, they relate farther, that not only little Springs have iſſued, but ſuch Deluges as have even overflowed Cities. This might ſeem ſtill more probable to thoſe, who thought with *Thales*, according to *Seneca*, that the Earth floated like a Ship upon the Surface of Water. But this will appear abſurd to thoſe, who know the real Structure of the terraqueous Globe.

The Water, which burſt forth in the mentioned Part of *Apulia*, dried up gradually, and in the Space of a Month quite diſappeared: But the dry Sand retained a Smell of Sulphur for ſome Time. Thus *Pliny*, *Lib.* xxxi. *C.* 4, ſays, that Earthquakes pour forth Water, and ſuck it up again. Hence it is no Wonder, that Lakes, Fountains, and Rivers are ſaid to have appeared where they were not before; and to have dried up, where they formerly appeared.

It is generally reported, that the Wells poured out Abundance of Water at the Beginning of the Earthquake: But it is not to be imagined, that this was caused by the Shock; for then it must have been so violent, as to subvert the whole Kingdom of *Naples*. It must have been caused by new Waters flowing into the Springs.

The Water, which issued near *Tre Santi*, being examined, produced the following *Phænomena*.

1. Being compared with an equal Bulk of Rain-Water, and examined by the Areometer, it exceeded the Weight of it in this Proportion, that where the latter weighed ℔ j, the former weiged ℔ j Gr. 82: But it weighed only Gr. 15 more than the Spring-Water, which is saltish there.

2. A Pound of the same Water distilled to Dryness left ℥ss of a Substance approaching to *Crocus Martis* sprinkled with ℈j of white, insipid Earth. The Magnet being applied to this Powder when dry, attracted some reddish Particles. During the Distillation, a Smell of Sulphur was very evident. This is a fresh Confirmation of *Lemery*'s Experiments, which prove that subterraneous Fires and Volcanoes are caused by a Mixture of Iron and Sulphur; and consequently Earthquakes may be caused by a Succession of hidden Fires.

3. Having infused ℥iij of Galls finely powdered in ℔ ij of that Water, in a Quarter of an Hour it began to turn blue; and then the Powder precipitated.

This is an exact and true History of our Earthquake, without any of the hyperbolical Fancies, which are common in the Mouths of the Vulgar on these calamitous Occasions.

Naples, Dec. 12, *N. S.* 1732.

Of the same, by the Hon. Henry Temple, *Esq; Son of the R. Hon. the Lord Viscount* Palmerston. No. 456. *p.* 340. Jan. *&c.* 1740.

2. They tell me, the last Earthquake here has made a great Crack in the Side of Mount *Vesuvius*, above 30 Yards long. I am not sure if this be true or not, though I think it very possible; but I made another Observation upon it, which I think much more extraordinary; which is, that the second Shock, which was a very slight one, had a great Effect upon the Nerves: I and all the Company where I was, as soon as the Shock was over, were seized with a Shaking, just as if we all had the Palsy, our Teeth chattering in our Heads to such a Degree, that we could hardly speak; and I find, that half the Town felt the same Effect from it. It would be natural to imagine, that this Shaking was caused by the Fright, but it is easy to prove the contrary; because, in the first Place, the first Shock, which was much more terrifying, had not that Effect: Secondly, many People who were not sensible of the Earthquake, found themselves seized in the same Manner: Thirdly, Mr ———, who used to be troubled with convulsive Fits, and had got quite cured of them here, was immediately seized with them again, after the Earthquake; and, fourthly, every Body, more or less, complained of Head-achs for some Days after.

XI. *Sept.*

XI. *Sept.* 5, 1732, about 11 in the Morning, an Earthquake was felt in diverſe Places in *Maryland*; the moſt particular Account I have heard of it, was from Mr *Chew*. It ſhook his Houſe for ſome Time, and ſtopped the Pendulum of his Clock; during it's Continuance, a rumbling Noiſe was heard in the Air, and many People who did not feel the Shaking, as well as thoſe who did, complained of a Dizzineſs in their Heads, and Sickneſs at their Stomachs: At the ſame Time, I have been credibly informed, it was felt in *Penſylvania* and *New-England*; but I have not heard whether it extended to *N.* or *S. Carolina*.

An Account of an Earthquake in Maryland, *by Mr* Richard Lewis. No. 429. *p.* 120. July, *&c.* 1733.

XII. That this Country is ſubject to Earthquakes, is certain; and we have been often admoniſhed of it ſince the firſt Settlement of the *Engliſh* here, which now is about 100 Years. Our printed Books and other good Records have taken Notice of the moſt remarkable that have happened. The firſt and moſt conſiderable Earthquake that I find in our Hiſtory, and which ſeems to have been much like our laſt, was on *June* 2, 1638. This is ſaid (by the Author, who was a Gentleman of Character and Probity) "to have been a great and fearful Earth-"quake: It was heard before it came, with a rumbling Noiſe or low "Murmur like unto remote Thunder; it came from the Northward, "and paſſed Southward; as the Noiſe approached near, the Earth be-"gan to quake; and it came at length with that Violence, as cauſed "Platters, Tyles, *&c.* to fall down; yea, People were afraid of their "Houſes. The Shock was ſo violent and great, as that ſome being "without Doors, could not ſtand, but were fain to catch hold of Poſts, "*&c.* About half an Hour after, or leſs, came another Noiſe and "Shaking, but not ſo loud nor ſtrong as the former: Ships and Veſſels "in the Harbour were ſhaken, *&c.*" In 1658, there was another very great Earthquake, but no Particulars related. In 1660, *Jan.* 31, a great Earthquake. In 1662, *Jan.* 26, about 6 at Night, there happened an Earthquake, which ſhook the Houſes, cauſed the Inhabitants to run out into the Streets, and the Tops of ſeveral Chimnies fell down. About the Middle of the ſame Night was another Shake; alſo in the Morning following the Earth ſhook again. In 1665, and in 1668, and 1669, the Earth was ſhaken; ſince which we have alſo had ſeveral Tremors of the Earth, but not very conſiderable; ſo that our People began to hope we ſhould hear no more of them. But we are now convinced to Purpoſe, that *New-England* is ſtill liable to the ſame Terror and Deſolation that other Countries are from theſe extraordinary Motions of the Earth.

An Account of the ſeveral Earthquakes which have happened in New-England, *ſince the firſt Settlement of the* Engliſh *in that Country, eſpecially of the laſt*, Oct. 29, 1727. *Communicated to the* R. S. *by* Paul Dudley, *Eſq; F. R. S.* No. 437. *p.* 63. April, *&c.* 1735.

I now proceed to give the beſt Account I can of our late terrible Earthquake, which has ſo juſtly amazed and terrified the Inhabitants from one End of the Country to the other. The firſt Thing I ſhall begin with, is to give a ſhort Account of the Weather or Seaſon preceding the Earthquake: Our Winter in *Jan.* and *Feb.* was very moderate, and excepting a few cold Days, the Weather was pleaſant, and no great Froſt in the Ground. In the Beginning of *March* we had a great deal

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of Snow, and ſome cold Weather, which ſoon went over; and on the 11th, 15′ after 4, the Sun was eclipſed about 5 Digits, as near as I could make it without an Inſtrument; after which to the End of the Month we had pleaſant Weather, Rain at Times, and once we had Thunder and Lightning. *April* for the moſt Part had fair pleaſant Spring Weather, and a plentiful Rain in the Beginning and latter End of the Month. The Beginning of *May* was alſo pleaſant Weather; the 9th, 10th, and 13th, a great deal of Rain: The 18th, a white Froſt: 24th and 25th, cold Weather; from thence to the End of the Month very dry. The Beginning of *June* the ſame; Abundance of Thunder and Lightning at Times during the whole Month. In *July* alſo, though we had ſome Showers in different Places, yet in general it was a very dry Seaſon, and a great deal of Thunder and Lightning alſo this Month; the 3 laſt Days of it ſo violent hot, that there was no working or travelling by Day, or ſleeping by Night: The Beginning of *Aug.* was alſo exceeding hot, and in particular the firſt Day at Night from the Evening to Midnight we had a continued Coruſcation or Lightning all round the Horizon; the like ſcarce ever remembered: It was truly terrible, though the Thunder was not ſevere. Dry Weather continued to the 10th, and then we had a plentiful Rain all over the Province, but our hot Weather held on to the End of the Month; and till about the Middle of *September* we had very hot Weather: So that take it all together, I have never known ſo much hot Weather in any one Summer in my Time. *Sept.* 16, we had ſuch a violent Storm from the N E, as was never remembered, for the Fierceneſs and Strength of the Wind; it blew down Houſes, Barns, and an infinite Number of Trees in our Orchards and Woods; a great deal of Rain alſo then fell. In *Oct.* preceding the Earthquake, we had a pretty deal of cold Weather; on the 23d, a great deal of Rain, with the S. Wind; on the 25th at Night, a hard Froſt; on the 26th, winteriſh Weather, and a little Snow; 28th, cold, the Wind at N W: 29th, the Wind at N W, though little of it, but cold; in the Evening quite calm, and a clear Sky.

By this ſhort Journal of the Weather the Learned will be able in ſome Meaſure to ſay, how far our Earth might be diſpoſed to, or prepared for, the Earthquake that followed; firſt by a long continued Drought and extreme Heat, whereby the Earth became more porous, and abounded with Exhalations or Vapours inflamed, and which afterwards being ſhut up by the ſucceeding great Rains and Froſt, and thereby hindered from an ordinary and eaſy Paſſage through the Pores and common Vents of the Earth, worked ſo much more forcibly and terribly upon one another. But Philoſophers not being yet agreed on the Nature or certain Cauſes of Earthquakes, I paſs on to the ſecond Thing which I propoſed to enquire into, *viz.* what Kind or Sort of Earthquake ours was. *Gilbertus Jacchæus*, in his *Inſtitutiones Phyſicæ*, *cap. Terræ Motus*, diſtinguiſhes Earthquakes into four Species; wherein he agrees with

with *Ariſtotle* and *Pliny*, with whom the firſt Species is a Shake or Trembling, and by them likened to the ſhaking Fit of an Ague. I cannot yet hear of any Breach or Opening of the Earth, through the whole Extent of our Earthquake. It has been ſaid by ſome that were abroad, that the Earth ſenſibly roſe up, and ſo ſank down again; but I much queſtion the Truth of it; for if there had been any ſuch Succuſſion to raiſe the Earth to any conſiderable Height, the Houſes would certainly have tumbled down, or the Exhalation forced it's Way by ſome Breach. Nor was our Motion of the Earth that which *Ariſtotle* and *Pliny* call a Pulſe, or an intermittent Knocking, but one continued Shake or Trembling; and therefore muſt be ranked under the firſt Species, *viz.* a Tremor or Shake, without altering the Poſition of the Earth, and left all Things in the ſame Poſture in which it found them, except the falling down of the Tops of ſome Chimnies, Stone Walls, *&c.* without Doors; Diſhes and ſome other Things within Doors; which I ſhall obſerve when I come to ſpeak of the Degree of the Shake.

That our Earthquake was of the firſt Species, is alſo proved from the Sound that accompanied it, ſince tremulous and vibrating Motions are proper to produce Sounds; which brings me to the third Particular, *viz.* the Noiſe or Sound that accompanied or immediately preceded our Earthquake. This indeed was very terrible and amazing; though I am apt to think it was thought more conſiderable by thoſe within Doors, than ſuch as were without in the Air. Some of our People took this Noiſe to be Thunder; others compared it to the Rattling of Coaches and Carts upon Pavements, or frozen Ground. One of my Neighbours likened it to the ſhooting out of a Load of Stones from a Cart under his Window. For my own Part, being perfectly awake, though in Bed, I thought at firſt my Servants, who lodged in a Garret over my Chamber, were haling along a Trundle-Bed: But, in Truth, the Noiſe that accompanies an Earthquake ſeems to be *ſonus ſui generis*, and there is no deſcribing it. This Noiſe, as amazing as it was, in an Inſtant of Time, as one may ſay, was ſucceeded by a Shake much more terrible. My Houſe, which is large and well built, ſeemed to be ſqueezed or preſſed up together, as though an hundred Screws had been at Work to throw it down; and ſhook not only every Thing in the Houſe, particularly the Bed under me, but the Building itſelf, and every Part of it ſo violently for the Time, that I was truly in great Fear it would have tumbled down, and my Family periſhed in the Ruin: But through the great Power and Mercy of God, we received no Harm. It is impoſſible to deſcribe the Terror and Amazement that an Earthquake carries with it; and though I had never felt one before, yet I was thoroughly convinced what it was at the very Time.

The next Thing I proceed to, is the Degree or Greatneſs of the Shake. This will be beſt known from it's Effects. I have already mentioned the falling of the Tops of Chimnies, Diſhes from Shelves, *China* Ware, *&c.* Doors unlatched, Bells jangling, Beds trembling,

Chairs

Chairs moving, *&c.* A Country Farmer tells me, he had 40 or 50 Rods of Stone Wall thrown down by it: And though I acknowledge theſe Effects are not very conſiderable, yet I cannot but be of Opinion, that our Earthquake, for it's Species, was as violent and terrible as any we meet with in Hiſtory: And had the Tremor continued a Minute longer, or been repeated in the like Degree, our Houſes had doubtleſs been many of them overthrown. One of my Neighbours that was walking home at the very Inſtant, tells me, the Noiſe firſt brought him to a Stand, and that during the Shake, the Earth trembled ſo under him, that he was ſo far from attempting to continue his Walk, that it was as much as he could do to keep upon his Legs, and expected every Moment the Earth would have opened under him. Another that was riding home, ſays, that upon the Noiſe the Earthquake made, his Horſe ſtood ſtock ſtill, and during the Shake, trembled to that Degree, that he thought he would have fallen under him. Our Houſe-Dogs were alſo ſenſible and affected with the Earthquake; ſome of them barking, others howling, and making ſtrange and unuſual Noiſes. Nor was our Earth only affected with this Shake, but the Sea alſo in our Harbours, and our Shipping ſmall and great much moved with it. I do not ſuppoſe it ever happens that Earthquakes of this Kind, of any Extent, are equal or alike in all Places; and accordingly I find by Information from our ſeveral Towns, that the Shake was much more moderate in ſome Parts of the Country than others.

The Time and Duration of the Shock——Our *Boſton* News-Papers fix the Time at about 40′ after 10 at Night: My own Watch was not ſo much by 5′; but the Clocks of the Town might be trueſt. The firſt Day of *Nov.* at Midnight, which was 3 Days after the Earthquake, the Moon changed. As to the Duration of the Shock itſelf——Whatever others may print or have printed, I can by no Means ſuppoſe it exceeded the Space of a Minute, if it was ſo long; I mean the firſt and great Shock; after which in the ſame Night we had 4 or 5 more leſſer Tremors; and at ſundry Times ſince the Earth has trembled in different Places (even to this *Nov.* 13) but without any conſiderable Effects or Extent.

The laſt Thing I have to mention, is the Courſe and Extent of the Earthquake. *Boſton*, the Metropolis of this Province, lies in Lat. of 42° 25′ N. and 4^{h} 43′ W. of *London*; as the Longitude between the two Places was ſettled by Mr *Thomas Brattle* of this Country, and Mr *Hodgſon* of *London* many Years ſince: And making *Boſton* a Centre, we have a certain Account, that our late Earthquake was felt in *Kennebeck River* to the Eaſtward, and at *Philadelphia* to the Weſtward, 150 Leagues diſtant one from the other upon a W S W and E N E Courſe neareſt: And no Part of the intermediate Country, that I can underſtand, eſcaped the Shake; the Colonies of *Rhode-Iſland*, *Connecticut*, and *New-York*, that lie between us and *Penſylvania* being all affected, though not equally, particularly at *Philadelphia* they write, a ſmall Shock. As

to

to the oppoſite Line or Latitude, as we may call it, of the Earthquake, we have two noted Iſlands to the S E, called *Nantucket* and *Martha's Vineyard*, about 90 Miles diſtant from *Boſton*, and the firſt named lies about 12 Leagues into the Sea, diſtant from the main Land; both theſe Iſlands had the Earthquake. Our *Engliſh* Settlements towards the N W, do not yet exceed 40 or 50 Miles from *Boſton*; but they all of them had this Earthquake very ſenſibly; and how far it might reach beyond them towards *Canada*, we cannot yet ſay. By this Calculation I believe it will be found, that our Earthquake was of a much greater Extent, than any yet taken Notice of in Hiſtory: As to the Courſe of the Earthquake, or where it firſt began, I am not yet able to determine by all the Information I can get: For they write from *Rhode-Iſland*, *Connecticut*, *New-York*, and *Philadelphia*, all to the Weſtward, that it was between 10 and 11 at Night. The ſame again is affirmed from *Piſcataqua*, *Caſco-Bay*, and *Kennebeck River*, which are to the Eaſtward: So that as yet it ſeems to me, that the Earth, through the whole Extent aforeſaid, was ſhaken very near at the ſame Time. Some of my Neighbours are poſitive, that it came from the Southward; while others again are confident, that where they were, it came from the North. But this is not to be wondered at, ſince, as I ſuppoſe, the ſubterraneous Channels or Caverns, through which the Exhalation paſſes, are not in any one continued ſtreight Line, but branched out, and running upon all Points of the Compaſs, eſpecially in ſuch a vaſt Extent of Land.

I am now come to *Nov.* 28, and having met with ſome further Particulars omitted in the preceding Account: I ſhall throw them into a Poſtſcript.

A Neighbour of mine, that has a Well 36 Feet deep, about 3 Days before the Earthquake, was ſurprized to find his Water, that uſed to be very ſweet and limpid, ſtink to that Degree, that they could make no Uſe of it, nor ſcarce bear the Houſe when it was brought in; and thinking ſome Carrion was got into the Well, he ſearched the Bottom, but found it clear and good, though the Colour of the Water was turned wheyiſh or pale. In about 7 Days after the Earthquake, his Water began to mend, and in 3 Days more returned to it's former Sweetneſs and Colour. I am alſo very credibly informed, that ſeveral Springs and good Watering-Places were ſome of them lowered, and others quite ſunk and loſt with the Earthquake. A worthy Divine in a Town about 20 Miles from *Boſton*, aſſures me, that immediately after the Earthquake, there was ſuch a Stink or ſtrong Smell of Sulphur, that the Family could ſcarce bear to be in the Houſe for a conſiderable Time that Night. The like is confirmed alſo from other Places. Perſons of Credit do alſo affirm, that juſt before, or in the Time of the Earthquake, they perceived Flaſhes of Light. A Gentleman of Probity from *Newbury*, a Town ſituated between 30 and 40 Miles to the N N E

of *Boſton*, writes Word, that at 40 Rods Diſtance from his Houſe, there was a Fiſſure of the Earth, and near 20 Cart-Loads of fine Sand thrown out where the Ground brake, and Water boiled out like a Spring, and mixing with the Sand, made a Sort of Quagmire; but at the Date of his Letter, which was the 21ſt current, the Spring was become dry, and the Ground cloſed up again. Since the Receipt of this Letter, I underſtand, that the Ground where this Sand is thrown up, and round about it for a conſiderable Diſtance, is a ſolid Clay for 20 or 30 Foot deep, and nothing like Sand ever to be found there before; ſo that the Exhalation forced this great Quantity of Sand through a very deep *Stratum* of Clay. I am alſo very well ſatisfied, that the Earthquake was more violent in the Towns to the N. and N E of *Boſton*, than in thoſe to the Southward and Weſtward; and in ſome of them that are rocky, the Earth ſhook but a few Days ſince.

An Account of a Shock of an Earthquake felt in Suſſex, Oct. 25, 1734, *communicated to the* R. S. *by* Charles *Duke of* Richmond *and* Lenox, *&c. F. R. S.* No. 444. *p.* 361. Nov. *&c.* 1736.

XIII. 1. I know moſt of the People that have ſigned the incloſed Papers, to be Perſons of Veracity: And what confirms me in my Opinion, that there really was an Earthquake, is, that almoſt every Body agree in the ſame Deſcription, as to the Senſation, the Hour of it's happening, and the perfect Calm that was at that Time. I obſerve the Shock was vaſtly more felt towards the Sea-Side, as at *Shoreham*, *Tarring*, *Goreing*, *Arundel*, and *Havant*. At my Houſe of *Goodwood*, which is near 3 Miles N. of *Chicheſter*, and about 7 from the Sea, it was not ſo perceivable as at *Chicheſter*, and where it was ſtill leſs ſo than by the Sea-Side. I do not hear as yet that there was the leaſt Touch of it in any Parts of the Vale on the N. Side of the Downs, which for the moſt Part run E. and W. I think, what Dr *Bayley* of *Havant* ſays of the different Motions of the Beds, according to the different Situations they were in, is very well worth obſerving. This Gentleman is a Doctor of Phyſick, and a very curious Man. I could have got above 50 more Accounts from the ſeveral Places I have mentioned; but as they all tend to the ſame Purport, I thought what I had already collected ſufficient.

Havant, *Octob.* 25, 1734.

A Narrative of the ſame Earthquake by Edward Bayley, *M. D.* Ibid. *p.* 362.

2. Between 3 and 4 in the Morning, an Earthquake was felt here: The Shock was ſo conſiderable as to be obſerved by one or other in moſt Houſes of the Town. I happened to be awake at that Time, and perceived the Bed ſhake under me with a quick tremulous Motion, which continued about 2 or 3″, then ceaſed; and after a very ſhort Intermiſſion was repeated in the ſame Manner, and laſted about the ſame Space of Time, as near as I could gueſs. I was at firſt much ſurprized at ſuch an unuſual Phænomenon; but upon a little Recollection, concluded it muſt be occaſioned by an Earthquake, and was ſoon confirmed in my Conjecture by the concurrent Obſervations of my Neighbours, and afterwards by Accounts of the ſame from many other Places; in ſome of which it ſeems to have been more violent than here. Several Perſons in this Place ſay, they not only perceived the ſhaking of their

Beds,

Beds, but alſo the rocking of their Houſes, together with a rumbling Noiſe of Drawers and the like moveable Goods in their Chambers and other Rooms. A learned and ingenious Gentleman in this Town informs me, that the Motion of his Bed appeared to him like the toſſing of a Veſſel when it croſſes over a Wave, the Head and Feet thereof riſing and falling alternately ſeveral Times; whereas mine ſeemed rather to rock from Side to Side: But theſe contrary Motions of the two Beds are eaſily accounted for, by conſidering the different Poſitions of them, my Friend's ſtanding directly E. and W, and mine N. and S. For ſuppoſing the undulatory Motion which the Earth might have at that Time was propagated from E. to W, the ſame Kind of Motion which cauſed his Bed to riſe up and down longways, muſt make mine rock from Side to Side; as may be obſerved in two Veſſels ſailing in contrary Directions on the ſame Waves of the Sea, that which croſſes the Waves at right Angels being toſſed up and down Endways, while the other moving in a Line parallel with the Waves, will be rocked from Side to Side. What makes me the more inclined to think the progreſſive Motion of this Earthquake to have been from E. to W, is, becauſe it appears from the beſt Accounts I have yet had of it, that it was obſerved ſooner E. than Weſtward, and likewiſe extended further from E. to W. than N. and S.

It may not be amiſs to take Notice of ſome remarkable Phænomena which happened before and after, as well as ſome other Circumſtances which immediately attended this Earthquake, moſt of them agreeing with thoſe Signs which have been obſerved by the Learned to precede or accompany former Earthquakes in theſe and other Parts of the World. It is obſervable, that we have had of late more Rain and Wind for ſeveral Months ſucceſſively, than for many Years paſt; eſpecially from the Beginning to the Middle of this Month, about which Time it cleared up, and the Weather became ſuddenly very cold, with froſty Mornings, the Wind blowing generally pretty hard from N W. On *Wedneſday* the 23d, the Cold abated conſiderably; it was cloudy, but we had no Rain that Day. The 24th was very calm all Day; it rained moſt Part of the Afternoon, though the Mercury ſtood at 30 $\frac{2}{15}$. It continued very calm all Night, and rained hard for ſome Time before and after the Earthquake happened; but it ſoon cleared up, and we had a ſtrong Gale of Wind, which roſe within half an Hour, or, as ſome ſay, within a Quarter, afterwards: It continued blowing hard all the Forenoon. At 4 in the Morning I obſerved the Mercury continued at 30 Inches $\frac{2}{10}$, the Spirit of Wine at 55 $\frac{5}{15}$; having riſen about five Degrees ſince the late cold Weather.

N. B. My Barometer and Thermometer are both in one Frame, made by Mr *Haukſbee*. 29 *Oct.* 1734.

The Circumſtances related by his Grace, and by Dr *Bayley*, are backed by the united Teſtimonies of ſeveral; many of whom are known to his Grace to be Perſons of Veracity, and whom he procured to ſign

Certificates of what they obſerved concerning this Accident at *Chicheſter* and other Places. It is unneceſſary to trouble the Reader with each Certificate; the mentioning the Names of thoſe who have ſubſcribed them may ſuffice.

John Fletcher, *Andrew* and *Sarah Adaire*, *Jane Johnſon*, *Martha Freeland*, *Owen Apps*, *Sarah Bryers*.

Sarah Tutte, and her Children *Eleanor*, *Jane*, and *Sarah*.

John Coſtellow, *John Freeland*, *Matthew Fathers*.

John and *Sarah Bryers*, *John Long*.

Thomas Turgis, *Richard Silverlock*: All of the City of *Chicheſter*.

Philip Boiſdaune, Eſq; of the Pariſh of *Funtington* in the County of *Suſſex*.

This laſt-mentioned Gentleman, and the aforeſaid Perſons, dwelling in the City of *Chicheſter*, all agree that there was a manifeſt Shock of an Earthquake felt on *October* 25, about a Quarter before 4 in the Morning, which laſted by Fits ſome few Seconds, about a Quarter of a Minute, or while one might tell twenty, with a Motion ſenſibly ſlow: For moſt of the Accounts concur in this Particular, that the Chairs, Wainſcot, Doors, Cheſts of Drawers, and other Moveables, were heard rattling; and one, that a Bell rung of itſelf juſt before they felt the heaving of their Beds; and that there was no Wind ſtirring at that Time, but that it rained, and the Wind roſe ſoon after.

The Rev. Mr *Richard Green*, Prebendary of *Chicheſter*, and Rector of *Merſton*, in the County of *Suſſex*, had Informations of the ſame Tremblings, attended with the ſame Circumſtances, being felt at *Shoreham*, *Goreing*, *Tarring*, *Findon*, *Arundel Caſtle*, and *Merſton*.

John Shaw, *Thomas Dagly*, and *John Towner*, all Servants to the Duke of *Richmond*, at his Seat called *Goodwood*, felt the ſame.

Mr *John Jenkins*, Riding-Officer of the Cuſtoms, in the Pariſh of *Weſt-Wittering*, near *Bragleſham-Bay*, in the County of *Suſſex*, deſcribed the Shock after the ſame Manner: And he adds further, that within half a Quarter of a Mile of his Houſe, a young Man, of about 18 or 20 Years old, having been at the ſame Time to fetch up a Team of Horſes from Graſs, the Horſes were ſo ſenſible of ſomething more than ordinary, that they trampled, and ſeemed very much affrighted, as they were coming home.

A Shock of an Earthquake felt in Northamptonſhire, *in* Oct. 1731. Ibid. p. 367.

XIV. To the foregoing Accounts of an Earthquake felt in *Suſſex*, it is thought not improper to ſubjoin, from the Regiſters of the *Royal Society*, the following Intimation from the Rev. Mr *Joſ. Waſſe*, Rector of *Aynho* in *Northamptonſhire*, of "a Shock of an Earthquake felt there "on *Sunday*, *Oct.* 10, about 4 in the Morning, 1731. This Gentle- "man ſaith, that his Windows rattled, as if ſomebody had been "dancing over-head. The Concuſſion laſted about a Minute; others "thought it laſted about 2'. It alarmed the neighbouring Villages, "*Bloxham*, 4 Miles S W from *Aynho*; *Barford*, 5; *Banbury*, 4 W; "*Adderbury*, a Mile W; *Crowton*, a Mile to the E; and *Charlton*, as

"much

" much to the N. There was no Notice of it's Progreſs S. or S E.
" About a Minute after, ſome of the Town of *Aynho* ſaw a great Flaſh
" of Lightning. In the Morning the Sky looked of a Land-Colour.
" It was ſaid that there was a former Shock felt upon *Oct.* 8, about 3
" in the Morning; and that the latter was preceded by a Noiſe like
" diſtant Thunder."

It is remarkable, that this Shock was perceived to extend more from E. to W, than from N. to S; which Particular was likewiſe obſerved in the laſt Shock felt in *Suſſex* 1734.

XV. *Oct.* 29, 1727, about 10^h $40'$ *p. m.* there came a great rumbling Noiſe; but before the Noiſe was heard, or Shock perceived, our Bricks upon the Hearth roſe up about $\frac{3}{4}$ of a Foot, and ſeemed to fall down and loll the other Way, which was in $\frac{1}{2}$ a Minute attended with the Noiſe or Burſt. The Tops of our Chimneys, Stone Fences, were thrown down; and in ſome Places (in the lower Grounds, about 3 Miles from my Houſe, where I dwell) the Earth opened, and threw out ſome hundred Loads of Earth, of a different Colour from that near the Surface, ſomething darker than your white Marl in *England*; and in many Places, opened dry Land into good Springs, which remain to this Day; and dried up Springs, which never came again. It continued roaring, burſting, and ſhocking our Houſes all that Night. Though the firſt was much the loudeſt, and moſt terrible, yet 8 more, that came that Night, were loud, and roared like a Cannon at a Diſtance. It continued roaring and burſting 12 Times in a Day and Night, until *Thurſday*, *Nov.* 2, and then was not ſo frequent; but upon *Friday* in the Evening, and about Midnight, and about Break of Day upon *Saturday*, 3 very loud Roarings: We had the roaring Noiſe upon *Saturday*, *Sunday*, *Monday*, about 10 in the Morning, though much abated in the Noiſe.

A Journal of the Shocks of Earthquakes felt near Newbury *in* New-England, *from the Year* 1727, *to the Year* 1741, *by the Rev. Mr* Matthias Plant. N. 462. *p.* 33. *Read* Feb. 14, 1741-2.

Nov. 7, being *Tueſday*, about 11, it roared very loud, and gave our Houſes a great Shock; and continued ſhocking from 3 Times to 6 every Day and Night until *Nov.* 12, when it was heard twice in one Hour in the Afternoon, from half an Hour after three to half an Hour after four. Sometimes the Roaring of the Earthquake was loud, other Times it ſeemed at a Diſtance, and much abated. *Nov.* 13, being *Monday*, two Hours before Day-break, the Roaring was loud, and ſhook the Houſes. Upon *Wedneſday* following, half an Hour paſt 2. in the Afternoon, there was a Roaring, but not ſo loud. It continued ſometimes roaring loud, and ſhocking our Houſes, for 5, 6, to 10 Times a Week, until *Dec.* 17 following; and then about half an Hour paſt 10 in the Evening, being *Sunday*, it roared very loud, and ſhook our Houſes very much; another Shock the next Morning about four, much abated.

Jan. 3, 1727-8, about 9 at Night, an eaſy Shock.

Jan. 6, *Saturday*, there were five Shocks, attended with the Roaring, from about 9 at Night to 4 on *Sunday* Morning, which I heard;

and

and ſome People told me, who lived in the low Grounds, that for the Space of about half an Hour, it continually kept roaring every half Minute or Minute.

Upon *Wedneſday*, *Jan.* 24, about half an Hour after 9 at Night, it roared exceeding loud, and was followed in half a Minute with roaring much abated in the Noiſe.

Jan. 28, *Sunday*, about half an Hour after 6 in the Morning, another eaſy Shock, and another about 10 the ſame Morning, eaſy: On the ſame Night about one, a loud Roaring and Shock.

Jan. 29, I heard it twice, though eaſy, that Day.

Tueſday, *Jan.* 30, about 2 in the Afternoon, there was a very great Roaring, equal to any but the firſt, for Terror: It ſhook our Houſes ſo, as that many People were afraid of their falling down; Pewter, *&c.* was ſhaken off our Dreſſers; the People that were in the Church for Evening Service, ran out; the Lead Windows rattled to ſuch a Degree, as that I thought they would all be broken. And there was another Shock the ſame Day, about an Hour and half after, though much abated.

Feb. 21, about half an Hour paſt 12 at Midnight, a conſiderable loud Roaring with a Shock.

Feb. 29, ſuch another.

March 17, about 3 in the Morning, an eaſy Shock.

March 19, 40′ paſt one at Noon, a ſmall Noiſe; at 9 the ſame Night, a ſmall Noiſe with a Shock.

April 28, 1728, about 5 in the Afternoon, a ſmall Noiſe, but perceivable.

May 12, *Sunday* Morning, about 40′ paſt nine, a long and loud Roaring, and ſhook the Houſes.

May 17, about 8 in the Evening, a long and loud Roaring ſhook our Houſes.

May 22, ſeveral ſmall Roarings in the Morning; but about 10 the ſame Morning, long and loud, and ſhook our Houſes.

May 24, about 11 at Night, loud and long Roaring ſhook our Houſes.

Thurſday, *June* 6, *Saturday* 8, about 3 in each Morning, a long and loud Roaring.

June 11, 9 in the Morning, a ſmall Noiſe.

July 3, about 2 in the Morning, and *July* 23, about Break of Day, very loud and long, ſhook our Houſes. Beſides theſe Times I have mentioned, it has been often heard by me; but the Noiſe was ſmall, ſo I forbore to ſet them down: I had Thoughts to have added no more Account of the Noiſe and Repetition of the Earthquake in my Church-Book; but acquainting my People with what I had done, they prevailed upon me to proceed again, which I did upon *March* 19, 1728-9. *Wedneſday*, betwixt 2 and 3 in the Afternoon, it was loud and long, ſhook our Houſes, being repeated twice in an Inſtant; and this was

the

the longeſt and loudeſt Roaring, and the greateſt Shock, that I ever heard, the firſt excepted, and that on *Jan.* 30, mentioned before. We had ſeveral ſmall Shocks in this Interim.——But *Sept.* 8, 1729, about half an Hour paſt 3, it was loud and long.

Sept. 29, about half an Hour paſt 4 in the Afternoon, loud and long.

Oct. 29, I heard it twice this Night; one of the Times was about the ſame Time of Night the firſt Shock was.

Nov. 14, about 8 in the Morning, loud and long, attended with two Burſts like unto two ſudden Claps of Thunder; ſhook our Houſes.

Nov. 27, about 8 in the Evening, a very great Roaring, and a great Shock: It was heard at *Ipſwich*, about 14 Miles diſtant.

Feb. 8, 1729-30, about 8 in the Evening, a ſmall Shock, about Midnight loud and long, and gave our Houſes a great Shock.

Feb. 26, about a Quarter before 2 in the Morning, the Noiſe was repeated twice in about one Minute: The firſt was loud and long, and ſhook our Houſes equal to any but the firſt Shock; the ſecond Noiſe was low, and ſeemingly at a Diſtance.

April 12, 1730, about 8 in the Evening, a very loud and long Noiſe, and a great Shock, equal, I thought, to any for Length and Noiſe, the firſt excepted.

July 28, about 9 in the Morning, a ſudden and loud Roaring and Shock.

Aug. 15, about 8 in the Morning, a Shock of the Earthquake, twice repeated in a Moment of Time.

Nov. 6, about 11 at Noon, it was loud and long, and gave my Houſe a Jar.

Nov. 14, about 9 in the Morning, a ſmall Noiſe and Rumbling, no Shock.

Nov. 25, about 20′ paſt 8 at Night, a loud and long Roaring, and gave my Houſe a conſiderable Shock.

Dec. 6, about a Quarter of an Hour before 11 at Night, it was loud, and roared long, and made our Houſes jar.

Dec. 11, about a Quarter before ſeven at Night, there was a ſmall Burſt, but ſhook my Houſe.

Dec. 19, about half an Hour paſt 10 at Night, the Earthquake did very much ſhake our Houſes, without any Noiſe or Roaring, more than ever before, the firſt Time excepted. It was felt at *Boſton* 40 Miles, at *Piſcataqua* 22 Miles, almoſt equal to what it was with us.

Jan. 7, 1730-1, about 7 at Night, it was loud and long, ſhook our Houſes.

Jan. 11, about Midnight, loud and long, ſhook our Houſes.

March 7, about 5 in the Evening, we heard the Noiſe, but no Shock.

May 28, 1731, about 9 in the Morning, I heard the Noiſe of the Earthquake very diſtinctly, but could not perceive that it ſhook.

July

July 5, about Sun-riſe, it was loud and long, ſhook our Houſes.

Aug. 21, 9 in the Evening, the Noiſe was ſmall and ſhort.

Oct. 1, about 11 at Night, loud and long, ſhook our Houſes.

Feb. 7, 1731-2, about 7 at Night, a great Shock, ſhook our Houſes.

Sept. 5, 1732, about Noon, we had a ſevere Shock, which was perceived at *Boſton* and *Piſcataqua*, but attended with little or no Noiſe. The ſame Earthquake was heard at *Mountreal* in *Canada*, at the ſame Time, and about the ſame Hour of the Day, and did Damage to 185 Houſes, killed 7 Perſons, and hurt 5 others; and it was heard there ſeveral Times afterwards, only in the Night, as the News-Papers gave us this Account.

Dec. 30, in the Morning we had a Shock, and it had been heard by ſome People ſeveral Times within 3 Weeks before.

March 1, a loud and long Noiſe of it.

Oct. 19, 1733, a loud and long Noiſe about Midnight.

Jan. 16, 1733-4, about 20′ paſt 10 at Night, a loud and long Roaring.

June 29, 1734, about a Quarter paſt 3 in the Afternoon, there was ſomewhat of a Noiſe of it.

Oct. 9, about 20′ paſt 10 in the Morning, a ſmall Shock.

Nov. 11 or 12, for it was about Midnight, we had the loudeſt Noiſe, and the greateſt Shock, except the firſt: It was long, very awful and terrible.

Nov. 16, about 6 in the Morning, there was a ſmall Shock.

Feb. 2, 1735-6, about a Quarter of an Hour before 6 in the Evening, there was a pretty loud Noiſe and Shock.

March 21, about half an Hour paſt 10 in the Morning, it was ſomewhat loud.

July 13, 1736, about three Quarters after 9 in the Morning, the Noiſe of it was loud.

Oct. 1, about half an Hour paſt one at Midnight, it was loud and long, and a great Shock, twice repeated in an Inſtant.

Nov. 12, about 2 in the Morning, there was a Shock with the Noiſe, and about 6 the ſame Morning it was ſomething louder.

Feb. 6, 1736-7, about a Quarter paſt 4 in the Afternoon, we had a conſiderable Shock.

Sept. 9, 1737, about 20′ paſt 10 in the Morning, it was very loud and long, and ſhook our Houſes very much.

Dec. 7, a little before 11 in the Night, the Ground ſhook very much, but we heard no Noiſe. Upon the ſame *Dec.* 7, at *New-York*, they had 3 ſevere Shocks of an Earthquake in the Night: It threw down there ſome Chimneys, and made the Bells to toll ſo as to be heard. At the ſame Time the ſaid Shock and Noiſe was felt and heard in many other Places.

Aug. 2, 1739, we had a great Shock; it made my Houſe ſhake much, and the Windows jar. It was about half an Hour paſt 2 in the

the Morning: I think I never heard but two either louder, or longer, or greater.

Dec. 14, 1740, about 35′ after 6 in the Morning, there was heard a pretty loud Noiſe of the Earthquake.

Jan. 18, 1740-1, about 4 in the Morning, there was heard the Noiſe of the Earthquake.

Jan. 25, 1740-1, about 10′ before 4 in the Afternoon, there was a Shock of the Earthquake, with a loud rumbling Noiſe. This is the laſt that has been heard (and I pray GOD I may never hear any more ſuch, and ſo long). I have omitted to ſet ſome down that were ſmall, or ſuch as I did not hear myſelf: I was very exact to the Time, ſo that what Account I have ſent you, is moſt certainly true.

I thought an exact Account of ſo remarkable a Judgment, continued ſo long, might be acceptable: And although the firſt Night was the moſt terrible, as the Surprize was ſudden, yet there never happened one Shock amongſt us, but what occaſioned ſome Alteration at that Time in every Perſon's Countenance and Conſtitution; and which Way ſoever any Perſon's Face happened to be, that Way the Noiſe of the Earthquake appeared to him: And I have frequently, in my Converſation with ſundry Perſons, been told by them, that for a few Minutes before a Shock of it came, they could foretel it by an Alteration in their Stomachs; occaſioned (as I ſuppoſed) by an Alteration in the Air: I atteſt to the Truth of the Thing by my own Experience.

P. S. I forgot to tell you, that (except the firſt Shock) theſe frequent Repetitions of the Roaring and Shocks of the Earthquake were upon *Merrimack River*, and ſeldom extended above 7 or 8 Miles Diſtance from, or 20 or 30 up the ſaid River; thoſe Inſtances only excepted, which I have mentioned in the Relation; and the firſt Shock of it was greater with us than any where elſe in *New-England*; and the Tops of Chimnies and Stone Fences were thrown down only in theſe Parts.

XVI. We have had here very unſettled Weather; continual Rains, ſometimes more, and ſometimes leſs; continual Winds, chiefly from the S. and W, ſo that ſcarce any in this City remember to have ſeen the like. We cannot be ſaid to want Wind here, ſince ſcarcely a Day paſſes without it, from ſome Point or other. But to obſerve in the Country one Wind in the Morning, another at Noon, and then a third at Night, is what ſurprizes us. In ſome Days, eſpecially after the Winter Solſtice, there have been felt extraordinary warm Southern Breezes, from whence People drew an ill Omen of the Health, or other Misfortunes, which every one figured according to his own particular Fancy: However, no one thought of the preſent Calamities, the Reaſons of which are unſeen by mortal Eyes; for where ſhall we find thoſe Teleſcopes through which our Sight may reach the ſubterraneous Receptacles of that Matter, which, whether burned or fomented, makes the whole Earth ſtart, and terrify Man? I look upon the Foreſight of

An Account of the Earthquakes felt in Leghorn, *from the* 16*th to the* 27*th of* Jan. 1742. *With ſome Obſervations made by the moſt Reverend Sig.* Paſqual *R.* Pedini, *Principal of the Clergy of the moſt eminent College of the ſaid City.* No. 463. *p.* 77. *Read* April 8, 1742.

theſe Accidents, as an Undertaking impoſſible to accompliſh, and the prophetic fixing them to a certain Time, much more ſo: But obſerve to what a Pitch Ignorance or Fear carries ſome People; after the firſt Shock of the Earthquake, every Body was in great Conſternation within this City, not ſo much for what they immediately felt, as through Fear of another infinitely more violent, which a certain *Milaneſe* Aſtrologer predicted to happen (as they ſaid) *Jan.* 28. By Misfortune he was within a Day of it, the great Earthquake being the 27th; by this Means the Faith and Credit given to the Aſtrologer increaſed ſo much, that I do not know whether he has not more Reverence and Honour ſhewn him than the Prophets, and holy Goſpel. There is no Need to prove, that this Science does not belong to Aſtrologers; for Effect ſhews it, ſince the Earthquake came a Day before his Prognoſtication. He has moreover predicted another Earthquake to happen *March* 6 next, upon which Numbers who are in the Country, and ſome at *Piſa*, will not return to *Leghorn* till that Day is paſt.

Jan. 16 was a very temperate Day, with a gentle Breeze between S. and W. A little after 24 Hours (about 6 at Night, according to the *Engliſh* Way of reckoning) I obſerved a certain dark Cloud, which paſſed with a bad Smell; of this I took but little Notice, having often ſmelt the like; and what might occaſion a greater Inobſervance, was, a great Cold, which prevented my diſtinguiſhing between Smells, whether good or bad: However, I ſaw this Cloud, blacker and thicker than the reſt, ſettle within a Foot and an half on the Tops of the Houſes, like the Smoke that the Peaſants make in an Evening, when they burn their Garden Rubbiſh, or ſuch-like. On account of the Cold I had, and this black Cloud, I went into a Friend's Houſe: Finding him with Company, after a little common Diſcourſe, he returned, it being *Tueſday*, and I remained with a few more. At 2 Hours in the Night, (8 *Eng.*) we thought the Pavement gave Way, and the Chamber ſhook: Some of us thought it proceeded from walking in another Chamber, others thought it was a Shock of an Earthquake; upon which I liſtened attentively, to hear if there might be any conſequent Motion or Noiſe in the Houſe, that I could attribute it to; but on the contrary every Thing was quite ſtill: Upon this I went to the Window, and found a ſmall Air from the South; the dark Cloud was no longer to be ſeen, but a thin ſlight Obſcurity in the Air. Scarce a Quarter of an Hour paſſed, but the Chamber received a more violent Motion than the former, though not to frighten us very much. I obſerved a Motion in the Candles on the Table from W. to E. We then heard all the Bells in the City; on this my Friends and I went out of the Houſe, and ſtaid abroad till 4^h. I ſmelt the Stink no longer, but obſerved the Clouds increaſing and thickening on every Hand, but always with a white Hue, like the Circle which is often ſeen round the Moon, but of a prodigious Extent. Every Body's Eyes were buſied at this, looking on it as the Forerunner of ſomething extraordinary, though no-body

knew what would be the Event. Many aſked my Opinion of this Novelty: I told them, I had obſerved the ſame Thing very often, and that the Conſequence was ſometimes Rain, or Wind, and very often nothing at all: In ſhort, I perſuaded them it was nothing out of the common Way, and did not portend any future Evil, as they thought. But returning home a few Minutes after 4 in the Night, I was got about half Way up the Steps, when another violent Shock began, far ſuperior to the two former, which laſted about the Time one might ſay an *Ave, Maria*; the Motion was ſudden, and the ſhaking of the Houſe was from E. to W. The Houſe wherein I live being S, and I ſtanding fronting it, ſtaggered twice to the Right-hand, and in great Danger of falling down all the Stairs.

At 10 Hours and a half were heard by many 2 other Shocks, (with a ſmall Intermiſſion of Time) much like the two firſt; however, I was not ſenſible of theſe. One waked me at $11^h\ 45'$, and another about an Hour after: Theſe were perceived by every Body, but were of no Conſequence; and I being between Sleep and Wake, could not tell which Way the Houſe moved. In the Morning, *Jan.* 17, after the laſt Shock, there fell a little ſmall Rain, like Hail, which turned to Snow about 14 or 15 Hours, which fell in ſuch Abundance for an Hour, that the Streets and Tops of the Houſes were quite covered; and a little more after Mid-day, which continued all the Remainder of the Day. On the 18th there were no ſenſible Shocks of the Earthquake, but there were now and then viſible Undulations of the Ground, though of no Conſequence. The 19th in the Morning, at Sun-riſe, there were between the E. and S. certain Clouds very thick, which diſperſed as they came nearer to the ſolar Diſk; but there always remained a particular uncommon whitiſh Thickneſs in the Air, till 16^h, when it was entirely diſſipated; a ſmall Gale roſe from the South, which ſoon fell again, and changed to the Weſt; the Sun was ſo ſcorching, that it racked the Head to ſtay in it. At $18^h\ 30'$ I heard a rumbling Noiſe, which ſeized me with Horror, and expected an Earthquake was at hand, neither was I deceived, the Houſe began to ſhake, and continued the Motion 8 or $10''$: It came like a Blow, and the Houſe waved from W. to E. At 19^h exactly, followed another Shock, which laſted about $3''$; but I did not obſerve any Motion of the Building, being ſo ſurrounded by Numbers of People, that I could not ſtir, nor raiſe myſelf from kneeling, being then at Church. All the Remainder of the Day, quite till 23^h, the Earth was in continual Motion; and exactly at 23^h followed another Shock, like that at $18^h\ 30'$. I felt nothing at all of this, by the Increaſe of the People, who poured in upon us. However, at 2^h, $3^h\ 30'$, and $3^h\ 50'$, I perceived 3 ſmall Shocks; and from that Time to *Jan.* 20, at $23^h\ 30'$, I felt nothing: At this Hour there was a ſmall ſhuddering, which was not univerſally obſerved. At $5^h\ 25'$ in the Night, followed a Shock like that of $18^h\ 30'$ of the 19th Day, with this Difference only, that the Houſe waved from S E, and con-

tinued between 10 and 12^{h}; there followed a ſtrong Undulation of the Ground (ſomething interrupted) until 20^{h} of *Jan.* 21; at 23^{h} of the ſaid Day, being in the great Piazza of the City, I found a ſmall Motion of the Ground, which was obſerved by a few more, that I happened to be in Company with.

Some Fiſhermen told me, that at the ſame Hour, *Jan.* 19, that we had the terrible Shock at *Leghorn*, they being at Sea between *Meloria* and *Gergona*, ſaw a ſmall Part of the Sea rage violently, and raiſe itſelf to a great Height in a white Foam, with a dreadful Roaring, and frighted them ſo far as to imagine themſelves loſt, though it did not directly beat upon them, but felt it on one Side only; which made them imagine ſome violent Miſchance at Shore; and keeping their Eyes always on that troubled Part of the Sea, perceived it made towards *Leghorn*, and broke on the old Fortreſs, which for a little while was hid from them. The Captain of a Ship, who came to this Port, ſays, that he ſaw, to his great Surprize, a few Miles diſtant from *Capo Corſo*, ſeveral Streams running with great Impetuoſity different Ways, and ſo very rough, that although he had a very fair Wind, he expected every Moment to be loſt. This muſt have happened juſt before the Earthquake of *Jan.* 19 above-mentioned.

From the 20th to 23^{h} of *Jan.* 25, the Ground was in a continual Agitation: I ſuſpected it might be my fooliſh Apprehenſions: I aſked every one I ſaw, but every body agreed there was ſome little Matter. To aſſure myſelf of the Truth, I put Water in a Baſon, and put it on a Plain, obſerving it every Time I thought I felt any Thing, and ſaw it move: I continued this Obſervation till *Jan.* 26, and at 23^{h} on the 25th Day, there was a much greater Motion than that of the 20th Day; and from that Hour until 18^{h} 45^{l} on the 27th Day, there was not the leaſt Motion perceptible: Upon this I hoped the Evil was paſt, and comforted myſelf with thinking that Matter ſpent to which the Philoſophers attribute this horrid *Phænomenon*; but found myſelf miſtaken, for when I leaſt expected it, and my Mind quite otherwiſe engaged, I was ſurprized the ſaid Hour with a moſt dreadful Noiſe, which was followed by a treble Shock of the Earthquake in the moſt frightful Manner, and beyond Meaſure violent; it began by a ſuccuſſive Motion, and followed by a Sort of Blow with horrible Violence; and at laſt came another ſuccuſſive Motion, more horrible than the former: There was heard from under-ground a hollow terrible Rumbling, as if the whole Earth had broken to Pieces: It had a Motion like turning, and continued moving; the Houſes waved 30 or 32$^{\prime\prime}$, from E. to W. I looked upon myſelf quite loſt, and expected nothing leſs than the immediate Ruin of the Houſe, eſpecially when I beheld Part of the Door-caſe falling, and the Partition-Walls cracked; the Mortar fell all about like Rain, the Furniture and Cloaths hung to the Walls fell all down; in this I was confined, without being able to ſeek Safety out of the Houſe, but ſtood fixed, and nailed up, (as it were)

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by the ſurrounding Crowd of frightened Wretches that flocked in upon me: At laſt, however, I got out, and could hardly believe my Eyes, when I found the Houſes all ſtanding, having figured Things much worſe than I found them; yet every Thing has ſuffered very much, there not being a ſingle Edifice but what is damaged; although a great Part of the Hurt within the Houſes proceeds chiefly from the Roguery of the Builders, who either when firſt built, or in repairing, uſed bad Materials; thoſe which are well built have ſuffered ſcarce any Thing: Some muſt inevitably be rebuilt, chiefly thoſe which remain leaning to one Side; which proceeds chiefly from the Load occaſioned by their being raiſed ſo high. What has moſt ſurprized me is, the Number of Cracks in the Walls of this Collegiate Church, which were built without ſparing any Coſt, to make them a compleat Piece of Workmanſhip, and are of an extraordinary Thickneſs, as one may obſerve in ſome of the Openings in the Building and Vaulting, which was eſteemed ſuperior to any in this Town: From hence you may conceive a juſt Idea of the extreme Violence of the roaring Earthquake. As for myſelf, I look upon it as a particular Providence, that the whole City did not go to Wreck; and had not the Houſes been in general very good, they muſt have come to the Ground. The Ruins conſiſt in, *viz.* the Roof of the Church of *St John Baptiſt*, the Convent of *Auguſtine* Friers, the Roof of a Palace called *Roſciano*, belonging to the Family of *Borgheſi* of *Sienna*. Beſides theſe there are few others of Conſequence, and but 3 People killed. There is an immenſe Quantity of Iron Chains uſed, to keep the Walls of the Houſes together.

Upon account of the Inconveniences attending this Earthquake, an infinite Number of People went out of the Town; the Houſes and Shops were abandoned inſtantly, to ſeek Refuge in the great Piazza: So great was the Conſternation, that no one knew what he was about. It was an Object of the greateſt Compaſſion, to ſee the Aſtoniſhment and general Confuſion that prevailed; every body looked pale as Death, without knowing what he did or ſaid. There was another ſmall Shock at $19^h\ 0'\ 1''$, at $19^h\ 15'$, and a third at 20^h: After this laſt, I ſtaid till 21^h of *Jan.* 30, and then went away to breathe a little of pure and more quiet Air than you enjoy, and obſerved no further conſiderable Motion of the Earth; there remained, however, a continual Undulation, ſometimes more, ſometimes leſs; but muſt own, that from 22^h of *Jan.* 27, to $13^h\ 30'$ of the next Day, I could not perceive any Thing, becauſe I retired, and went to lie on board a Ship.

We may obſerve here, that ſome Earthquakes happened in cloudy, ſome in ſerene, ſome in ſtill, and others in quite ſtormy Weather. *Jan.* 16 at Night was Snow and Clouds, as above-noted, with a very ſmall S. Wind from Midnight to Break of Day; the Fogginеſs turned into Clouds, which afterwards became Sleet and Snow. On the 19th in the Morning, was a bright Sun, but a gentle Breeze; about 23^h it was cloudy, which at laſt covered all the Sky, continuing cloudy all

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that Day and the next Night, when at 5^h $25'$ followed the above-mentioned Earthquake; and in the Morning about 13^h, there fell a ſmall Sleet and a Weſterly Wind. Before the Earthquake on the 19th, the Waters ſwelled, and then fell again; ſoon after they ſwelled half a Yard higher than they ever were uſed to do. I was told by many, that the ſame Night and the following, there was a ſtrong Smell of Sulphur in the Streets; but my Cold prevented it's being perceived by me. This Smell was likewiſe found in the Water of ſome Wells. The Sea was ſeen in ſundry Situations, now high, and then preſently very low again; ſometimes ſtrongly agitated, and at others on a ſudden calm. On *Sunday*, *Jan.* 20, a ſmall Sleet fell all Day, and the Air was changeable till the 27th in the Morning, being, by Turns, ſerene, cloudy, foggy, windy, and damp, with South and Weſterly Winds. The 27th in the Morning, was a pleaſant fine Sky, and a bright Sun, but exceſſive hot: About 16 or 17^h, a briſk Weſterly Wind aroſe, and with this full Wind we ſuſtained, at 18^h $30'$, the violent Shock of the Earthquake; the Waters were obſerved to riſe as high or ſomething higher than the 19th. At Night, between 24^h and 1^h in the Night, it became cloudy in the W, with a ſtrong Wind; from Midnight to Day-break, fell a ſmall Sleet, which continued (with ſome Interruption now and then) till the 28th; between whiles the Sun ſhone. The 28th at Night, and the 29th Day, it rained violently, accompanied by ſtrong bluſtering Winds from the W. The 29th it was all Day cloudy, with the ſame violent Wind and Rain. The 30th the Sun began to appear, but the Clouds were not all diſperſed. At 21^h this Day I left *Leghorn*, and have not been able to make any further Obſervations.

It is ſaid here, that the Sea roared with ſuch Violence and Smartneſs, that it's Noiſe was like the firing of large Cannon. I have not ſeen any body who was then at Sea, but a Friend of mine informed me, that a Fiſherman (a *Frenchman* by Nation) being then in his Boat, found it of a ſudden raiſed up a prodigious Height, and then it fell down ſo low, that he thought it had touched the Bottom of the Sea, and concluded himſelf loſt: During this uncommon Motion he affirms to have heard one of theſe Noiſes reſembling the firing a Cannon, and afterwards felt no Storm. I give it neither for true or falſe, but as a Relation of others. It is aſſured me by many, that on the ninth Hour of the 10th Day, there was a ſmall Shock of an Earthquake. Theſe are all the Obſervations I have been able to make myſelf, and gather from other creditable Perſons, having avoided the additional Stories that are commonly raiſed on ſuch Occaſions.

What has much attributed to the Preſervation of this City, is the fatherly Care and Solicitude of our Royal Sovereign, who, by the Means of his Royal Council of Regency, neither has or will ever fail giving us Inſtances of his Royal Munificence to this afflicted City; having ordered, that ſuch Wood, Iron, *&c.* ſhould be furniſhed as may be neceſſary for Repairs, with certain fixed Prices; having further ordered

ordered one half of the Duty to be taken off of Fleſh. He has alſo, at his own Expence, ſent a moſt able Engineer, and two Maſter-Builders, to eſtimate and ſuperviſe the ſaid Repairs: Neither has his Bounty failed to the more Indigent, who not having wherewithal to repair the Damages they have ſuffered by this Earthquake, he has ordered Money to be diſtributed for repairing them, that he may again ſee this his dear City veſted in it's former Beauty. The Aſſiſtance and Watchfulneſs of the civil and military Power was likewiſe very great, even during the Time of the Earthquake; for by their Means there were no Diſorders practiſed, not even in the Midſt of the Hurry and Confuſion, as it very commonly happens upon ſuch Occaſions.

P. S. I cannot omit to acquaint you with ſome Obſervations communicated to me after the writing of this Letter, by Sig. *Ferdinando Tidi*, a Gentleman of inconteſtable Credit, who being at his Seat in the Country, called *Popogna*, pretty high up a Hill, between the Mountain *Montenero*, and the Valley *Benedetto*, on *Jan.* 20, about 2^h $30'$ in the Night, he obſerved a large Circuit of Air in the Weſt, (quite from the Iſland of *Corſica* to *Capo Mele*) thickened with Clouds, but open, and all the Remainder of the Sky covered with heavy dark Clouds; he ſaw the Air light, and extremely ſhining, ſo that one might eaſily read a Book; and, according to his Deſcription, muſt have been a very bright *Aurora Borealis*. Beſides this, he obſerved that when we had the Wind from S. or E, the Sea was in great Agitation, and ran towards *Leghorn*, but ſuddenly retired. I will likewiſe tell you, that Sig. *Guiſeppi Vincenti*, Captain of the firſt *Lazaretto*, and preſent *Canfaloniere* of the City, a Perſon not eaſily to be impoſed upon, having one Night, at about 3^h, opened his Window, ſaw a Cloud in the W, which was exceeding dark, except in the Middle, where a ſtrong Light (like the Influence of the Sun juſt before it's Riſe) diſcovered itſelf, and diſperſed Beams of reddiſh Fire all over the Circumference of the Cloud, which was very extenſive. He made a Friend of his obſerve the ſame Thing, but neither one or the other remember what Night it happened; and being uncertain of the particular Night, is the Reaſon I omitted it in the Account: But ſince it happens, that I am treating of theſe *Phænomenons*, which may have ſome Relation to the Earthquake, and proceed from the ſame firſt Cauſe, I imagine it muſt have been the ſame Night, though perhaps not. However it may have been, I have related to you a true Expoſition of all Things as they really were; and there is now a Way opened for Philoſophical Obſervations and Inquiries. As for me, I ſhould be of Opinion, that it is a Collection of thoſe Vapours and Exhalations proceeding from the Fermentation or lighting of thoſe Particles of Matter, which occaſioned the Earthquake.

XVII. The Pariſh of *Pardines*, in the Diſtrict of *Iſſoire* (in *Auvergne*) is ſituated about a League from the Town of *Iſſoire* on the Road to *Clermont*, almoſt on the Top of pretty ſteep Hill.

A Narrative of an extraordinary Sinking down and Sliding away.

This

of ſome Ground at Pardines *near* Auvergne, *by M.* T———. *Tranſlated from the* French, *by* Phil. Henry Zollman, *Eſq; F. R. S.* No. 455, *p.* 272. Nov. *&c.* 1739.

This Pariſh conſiſts of two Villages, or Hamlets, diſtant from each other about 200 Paces; the one, which is called *Le Fort*, in which is the Pariſh Church, and Part of the Houſes of the Inhabitants, ſtands upon a Rock; there appear the Remains of an ancient Fortification, with which ſome Houſes were ſurrounded in the Time of the Wars.

The other Village, which is properly called *Pardines*, was compoſed of the greater Part of the Houſes of the Inhabitants to the Number of 46 Buildings; the Ground whereon this Village was built, as well as that of the whole Hill, is a good and light Earth, mixed with a little white Clay: There are alſo found in it ſome Stones and Rocks of a middling Size. This Land was very well cultivated, and very fruitful, conſiſting of Fields ſowed with Corn, of Orchards, and for the greater Part of Vineyards; the whole Ground was overſpread with Fruit-Trees, particularly Walnut-Trees.

This Earth uſed to dry ſoon and chap from the Heat; they even obſerved in it long ſince Clefts of a conſiderable Depth, which ſometimes growing wider and wider, formed ſeveral Gullies.

June 23, 1733, about 9 in the Evening, the Inhabitants of the Village of *Pardines* ſaw the Walls of their Houſes ſhake ſenſibly; whereupon they all retired out of them, and ſaw that the Hill viſibly melted away, as it were, the greater Part of the Land ſliding along towards the Vale; others ſubſided ſenſibly; in ſome Places the Earth, opening itſelf formed new Gulls, and thoſe that were obſerved there before, grew much wider; ſometimes the Ground, which ſlided along in great Pieces, ſtopped and tumbled one Piece over the other; and the Rocks, which broke looſe from that rolling Earth, precipitated themſelves into the Valley, which at preſent is quite filled up with them, as well as with the Earth which rolled down, whereby the Road from *Iſſoire* to *Clermont* is become impaſſable.

All this was done, not with any impetuous Motion, but very gently, and even ſometimes almoſt imperceptibly; a ſenſible Motion was obſerved during the Space of 3 or 4 Days at different Times; there was even a Houſe which did not fall till the 10th of the preſent Month of *July*. During all that Time no Noiſe was heard, any otherwiſe than what proceeded from the Rocks falling into the Valley, and from ſome large Clods of Earth, which looſening themſelves from the ſteeper Parts, fell down with Precipitation.

By this Rolling were carried away 26 Buildings, large or ſmall, ſome of which ſubſided with the Ground, and, being ſhaken at their Foundations, tumbled on a Heap; the Remains of ſome others appear, as yet, on thoſe Pieces of Ground that rolled down into the Valley.

It is computed, that the Lands which ſlided away, or were loſt by being buried under the Rubbiſh of the others, amount to the Number of 466 *Oeuvres* of Vineyards, 40 *Septerées* of arable Land, and 56 *Oeuvres* of Graſs-Fields, which all together may make up 150 Acres of *Paris* Meaſure. It is obſervable, that in this Number were compriſed

ſeveral

ſeveral Orchards, beſides that the whole Ground was covered with Trees, either Walnut-Trees on the Hill, or Willows or Poplars in the Valley, of which they reckon 4000 in all.

If one may conjecture what was the Cauſe of ſo diſmal an Accident, it ſeems it proceeded from the Situation of the Ground, and the Nature of the Soil. The firſt Surface of the Hill about 4 or 5 Foot deep, was a pretty light Earth, eaſily dried by the Heat of the Sun; under this firſt Layer there was a *Stratum* of fat Clay, which at preſent lies open in ſeveral Places, and is very moiſt, ſo that one even ſees the Water bubbling out of it in ſome Places.

The great Rains that fell in the Beginning of the Spring, ſoaked through and diluted this *Stratum* of Clay, which retained and gathered all the Waters of the Hill running between the two Layers; the Heat of the Summer enſued, which dried up the upper Surface, and formed it into a Sort of ſolid Cruſt, which Cruſt reſting itſelf upon a fat and moiſt Clay, and by it's ſteep Situation being inclined to ſlide towards the Valley, the whole Surface of it looſened itſelf by great Pieces, and breaking in ſeveral Places, ſlided along towards the Place whither it's Declivity would naturally carry it. There are ſome Parts which moved almoſt inſenſibly, and only ſunk or ſubſided, either becauſe the rolling of the neighbouring Soils made Room, that what was under this Surface might ſlide off, or perhaps becauſe the Parts under this Surface had been hollowed a long while ſince, by the Waters which paſſed between this Surface and the *Stratum* of fat Clay. Other Parts, which were much more in Number, rolled all together towards the Valley, and one ſees yet whole Pieces of Vineyards, with the Props remaining upright; which may eaſily be conceived: There are again other Parts, which in tumbling were overturned in different Manners.

I am to add here, that this Accident is not without Example in the Province of *Auvergne*; we have not indeed ſeen ſo conſiderable a one till now, yet it has often happened, that Pieces of Earth of a Quarter or half an Acre, have ſeparated themſelves all in one Piece, from the Top of a Hill, and ſlided down viſibly on the Lands lying below.

How conſiderable ſoever this Accident may be in regard to the poor People who ſuffered by it, yet it was to be wiſhed it was the only one that has befallen this Province. The overflowings of the River *Allier*, and of the Rivers and Brooks that run into it, and the Hail that fell almoſt continually ſince, have entirely ruined above 100 Pariſhes, in which they will have no Harveſt this Year as for Corn and Hemp, nor any Vintage at all.

An Account of the dead Bodies of a Man and Woman, which were preſerved 49 Years in the Moors *in* Derbyſhire; *by*

XVIII. The Perſons of whom you have the following Account were loſt in a great Snow on the *Moors*, in the Pariſh of *Hope*, near the *Woodlands* in *Derbyſhire*, *Jan.* 14, 1674; and not being found until the 3d of *May* following (the Snow laſting probably the greateſt Part of that Time) they then ſmelt ſo ſtrong, that the Coroner ordered them to be buried on the Spot. The Man's Name was *Barber*; he had been

Dr Charles Balguy *of* Peterborough. No. 434. *p.* 413. Sept. *&c.* 1734.

a conſiderable Graſier, and was well known by the People that found him: But being reduced in his Circumſtances, was then going off with his Servant-Maid for *Ireland*. They lay in the Peat-Moſs 28 Years 9 Months before they were looked at again, when ſome Countrymen, having obſerved, I ſuppoſe, the extraordinary Quality of this Soil in preſerving dead Bodies from corrupting, were curious enough to open the Ground to ſee if theſe Perſons had been ſo preſerved, and found them no Way altered, the Colour of their Skin being fair and natural, their Fleſh ſoft as that of Perſons newly dead. They were afterwards expoſed for a Sight 20 Years, though they were much changed in that Time, by being ſo often uncovered; and in the Year 1716, Dr *Bourn* of *Cheſterfield* was there, who gave me this Account of the Condition they were then in, *viz.* the Man perfect, his Beard ſtrong, and about a $\frac{1}{4}$ of an Inch long, the Hair of his Head ſhort, his Skin hard and of a tanned Leather Colour, pretty much the ſame as the Liquor and Earth they lay in: He had on a Broad-cloth Coat, which he tried to tear a Skirt off, but could not. The Woman, by ſome rude People, had been taken out of the Ground, to which one may well impute her greater Decay; one Leg was off, the Fleſh decayed, the Bone ſound, the Fleſh of one Hand decayed, the Bone ſound; on her Face, the upper Lip, the Tip of her Noſe decayed, but no-where elſe. Her Hair was long and ſpringy as that of a living Perſon. He took out one of the Fore-Teeth, the upper Part of which, as far as was contained in the Socket, was as elaſtic as a Piece of Steel; and, being wrapped round his Finger, ſprung again to it's firſt Form; but this Power was loſt in a few Minutes after it had been in his Pocket.

Mr *Barber* of *Rotheram*, the Man's Grandſon, was at the Expence of a decent Funeral for them at laſt in *Hope* Church, where, upon looking into the Grave ſome Time afterwards, it was found they were entirely conſumed.

Mr *Wermald*, the Miniſter of *Hope*, was preſent when they were removed: He obſerved that they lay about a Yard deep, the Soil or Moſs moiſt, but no Water ſtood in the Place at all. He ſaw their Stockings drawn off, and the Man's Legs, which had never been uncovered before, were quite fair; the Fleſh, when preſſed with his Finger, pitted a little, and the Joints played freely, and without the leaſt Stiffneſs: The other Parts were much decayed: What was left of their Cloaths (for People had cut away the greateſt Part to carry home as a Curioſity) was firm and good; the Woman had on a Piece of new Serge, which ſeemed never the worſe.

Theſe are all the Particulars of Moment which my Friends, who ſaw them at this Diſtance of Time, are able to recollect. The Thing is certainly very remarkable, as there are no Means known (I believe) of preſerving dead Bodies ſo well.

XIX. In

An Account of the Petrefactions near Matlock *Baths in* Derbyſhire; *with Conjectures concerning Petrefaction in general, by Mr* Moreton Gilks, *F.R.S.* No. 456 *p.* 352. Jan. *&c.* 1740.

XIX. In the mountainous Part of *Derbyſhire*, about *Cromford*, is a Valley of at leaſt a Mile and half long, walled on each Side with high craggy Rocks; the Eaſt Side cliffy, the Weſt more reclining, but extremely rough and difficult of Aſcent; being compoſed of large looſe Pieces of the Lime-Stone Rock, of 5, 10, or 20 Ton Weight; that ſeem at ſome Diſtance of Time to have broken off from the Top of the Cliffs, and fallen down into the Valleys.——At the Bottom of the Valley, which ſeems to be a great gaping Fiſſure of the Rock, runs the River *Derwent* harſhly along it's rocky Bottom. About the middle of the Valley, at near 50 Foot perpendicular Height from the River, iſſue forth ſeveral Rivulets of a luke-warm Water, that pour themſelves into the *Derwent* below. Some of this Water, being collected in a Reſervoir, on account of it's agreeable Warmth, hath of late Years been much uſed for bathing, and is called *Matlock-Bath*. Now for about the Compaſs of 5 or 600 Yards, near to where this Water guſhes out, the Stone appears of a very different Texture and Complexion; and proves, upon Examination, to be a perfect Incruſtation, formed upon the original Rock; compoſing a factitious Stone, of Earth, Vegetables, *&c.* of various Kinds, ſuch as uſually grow in rocky Places, as Polypody, Trichomanes, and other Species of the capillary Tribe, Moſſes, Brambles, Ivy, Hazle, *&c.*——There are ſeveral large Grotto's at about 15 Foot above the Level of the River, lined moſt curiouſly with the *Stalactitæ*, *Lapides Stillatitii*, &c. Some of them nearly reſemble large Bunches of Grapes, and other Cluſters of Fruit, very beautiful to look upon. I found upon Examination, that the farther you penetrate into this Mountain, the cloſer and more compact the Stone appears; the Interſtices in the petrified Matter being at the Depth of 15 or 16 Foot, almoſt filled up, and nearly as ſolid as the Lime-Stone, of which the original Rock is compoſed; and even within 4 or 5 Foot of the Surface, though very open and porous; yet is it ſo hard as to be uſed in the Building about the Bath; and I imagine it may be equally durable, though eaſier to work with the Saw, than the cloſe Lime-Stone.

The Mountain in ſeveral Places jets out almoſt over the Brink of the River; under theſe Protuberances are the Grotto's, very dangerous and difficult to get at. It was here the Specimens I ſend you were collected *, but it is impoſſible to give you an Idea of the natural Beauty of the Place. The Froſt-work, and incruſted Plants, are ſome of them ſo very delicate and tender, as to make it impracticable to bring them away with half their Beauty, by the moſt careful Conveyance. In one Place there is an Ivy creeping along the Rock, Part of it entirely petrified, another Part only incruſted, and a third ſtill vegetating. In another Place is a Hazle-Tree, the Root whereof compoſes a Part of this petrified Mountain, the Branches ſome petrified, and ſome tenderly incruſted. As theſe are changed, others ſpring up, and in Time will

* They are depoſited in the *Muſeum* of the *Royal Society*.

undergo the ſame Fate. In ſhort, nothing in Nature can give a more clear Idea, or more beautiful Repreſentation, of the whole Buſineſs of Petrefaction, than a curious Obſerver will ſee, and frame in his Mind from this Mountain. He will ſee, that not only the Water, as it diſtils out of the Rocks, is capable of incruſting and petrifying the Bodies it meets with in it's Paſſage, but that even the Steams and Exhalations *, being highly ſaturated with theſe mineral Particles, will work the ſame Effect; as is evident in the Place under Conſideration, and will generally beſt account for the Supply of petrifying Matter, brought to fill up the Vacuities that are left by the Decay and Waſte of Vegetables incruſted over; and which, he will ſee, are in Courſe of Time conſtantly filled therewith. For although the Water of ſome Springs may be ſo loaded with mineral Matter, as, perhaps by penetrating the Pores of Wood and other lax Bodies, to increaſe greatly their ſpecific Gravities; yet ſurely it is contrary to the Laws of Matter, and abſurd to ſay, there is any hidden Property in ſuch Waters capable of changing the Parts of one Body into another Body ſpecifically different. It may in Time, no doubt, loſe it's Texture and Coherency, by the Admittance of heterogeneous Particles of different Attractions; but the Cauſe of Coherency in the Parts of the original Body muſt entirely ceaſe, and be diſſolved, before it can be ſaid to become a Part of any other Body whatever. Afterwards, indeed, the Space that was poſſeſſed by the Parts of the original Body, may be ſupplied by thoſe of the new one, ſo as to make in Time a uniform Stone in the Shape of the original Plant: But if this petrified Plant be ſtill kept in the Place where the ſame petrifying Quality continues to act upon it, it will loſe even that Shape, and become a Part of the Body it is contiguous to; and ſo a great many of theſe petrified Plants, and other Bodies united together, will compoſe large Maſſes and whole *Strata* of Stone. This is clearly the Caſe in the Inſtance now before us, and perhaps it might be carried ſo far as to ſtrengthen our Conception about the general Formation of the *Strata* of Lime-Stone or Marble; that appearing to be every-where, (notwithſtanding Dr *Woodward* diſpatches them much more expeditiouſly †) but eſpecially in the *Peak* of *Derbyſhire*, ſuch a Petrefaction as I have been deſcribing, quite finiſhed. I could urge many Reaſons for my Suppoſition, but I will not trouble you with them here, the Compaſs of this Letter not permitting me; nor do I know how far ſuch Conjectures are capable of being uſed, with regard to the received Opinion of the World's Age; but if we had as good Authority to ſuppoſe it 60,000 Years old, as we have 6000, it would be worth the while to trace the Origin and Source of theſe petrifying Exhalations a little deeper than ſeems to have been done by Dr *Woodward*; and might either perfect his Hiſtory, or produce a more rational Syſtem of the Earth than has yet appeared.

* Vide *Woodward*'s Natural Hiſtory, *p.* 136, 209. † *Ibid.* Part II. Conſ. 4.

You

You will find, amongſt the Things I ſend, ſome Land-Coral found in a Lime-Pit, where is a great Quantity of it, between two *Strata* of Lime-Stone of at leaſt 3 Foot thick. You will find alſo ſome few Pieces of *Pſeudo-ſapphirus*, and other Kinds of Spar; they are ſuch as I picked out of the Fiſſures of the Rocks I have been deſcribing. There is a vaſt Variety of theſe Things in the *Peak*, much greater than hath been taken Notice of by any one; as I ſhall convince the *Royal Society*, when I am able to preſent them with a complete Collection of *Derbyſhire* Foſſils, in which I have already made ſome Progreſs.

Burton, Nov. 26, 1735.

Experiments concerning Quickſilver, by Herman Boerhaave, *M. D. F. R. S. &c.* No. 430. *p.* 145. Nov. *&c.* 1733.

XX. 1. *Exp.* 1. Pure Quickſilver being only ſhaken in a dry, clean, Glaſs Veſſel, affords a very fine, ſoft, black Powder.

Operation. I bought ℥xvi of Quickſilver of the *Amſterdam* Company, I ſqueezed it through Leather, and no Impurity remained. I waſhed it well with fair Water, and it continued pure. I rubbed it a good while with Sea-Salt, and the Colour of the Salt was not altered. I poured freſh Water upon this Salt and Quickſilver; and neither did this change Colour. In all this Operation there did not appear any Thing black, foreign, or foul, the Quickſilver being dried after the Ablution was bright. I poured it into a clean, dry Bottle, made of dark-green *German* Glaſs. I placed it in a Sand-Heat, with juſt Fire enough not to raiſe the Quickſilver; and that I might be ſure, that all the Water was got out, for there is often ſome concealed in Quickſilver, I kept it in that State for 3 Days. I ſtopped the Bottle very cloſe with a very ſolid, dry, clean Cork, thruſt into the Neck of the Bottle, whilſt it was hot; and cloſed it all over the Top with a Cement of Pitch, Reſin, Suet, and Sulphur. I covered it with Linen bound on faſt with Cords. I then put the Bottle into a wooden Caſe, fitting it ſo as to have the Sides touch; and filled the Spaces between the Bottle and the Caſe with dry Bran. The Lid of the Caſe had a Hole in the middle for the upper Part of the Neck of the Bottle to come out. The Bottle was tight in it's Caſe. Being thus prepared, I fixed it to the Hammer of a fulling Mill, that went Night and Day when the Wind blew: Thus it was continually ſhaken, by a perpendicular Motion up and down, from *March* 1, 1732, to *Nov.* 13 following.

The Veſſel being opened, there was the ſame Weight of Quickſilver, covered all over with a great Quantity of very fine, ſoft, black Powder. I ſqueezed it through a clean Leather. The Quickſilver came through clear and pure. The Powder ſtaid in the Leather, and had an acrid, metallic Taſte, ſomething like Braſs.

Coroll. 1. Quickſilver, a moſt inſipid Body of itſelf, acquires a metallic braſſy Taſte by mere ſhaking.

2. From being moſt mild, it becomes acrid and penetrating.

3. From a moſt ſhining Silver Colour, it becomes very black.

4. From a Fluid, it becomes a conſiſtent Powder.

5. It

5. It may therefore lie hid under the Form of ſuch a Powder, and deceive the Ignorant.

Exp. 2. The moſt purified Quickſilver, being treated after the foregoing Manner, affords the ſame Powder in a far greater Quantity.

Operation. Suſpecting that ſomething foreign from the Nature of Quickſilver might poſſibly adhere to it, and be ſeparated from it, by Motion in Form of that Powder, I brought over all the Quickſilver with a Sand-Heat from a Glaſs Retort; I poured it into the ſame Retort again, and diſtilled it as before. I repeated the Operation 60 Times. The Quickſilver was diſtilled 61 Times. At the Bottom of the Veſſel there were ℥v of red Powder, of which hereafter. This Quickſilver was very quick and ſhining. I got ℥ij of this to be ſhaken as before.

Effect. The Weight was the ſame. There was a ſoft, black Powder, of an acrid, metallic Taſte, reſembling Braſs to the Weight of ℥ij Gr. xxvj; which is more than $\frac{1}{5}$: Whereas ſcarce $\frac{1}{128}$ of the common Quickſilver was turned to Powder by the ſame Operation.

Coroll. 1. Quickſilver 61 Times diſtilled, and very inſipid, acquires a metallic Taſte.

2. From being moſt mild, it becomes acrid and penetrating.

3. From a moſt ſhining, bright, Silver Colour, it becomes exceeding black.

4. From more, than it's native Fluidity, it becomes a conſiſtent Powder.

5. A laſting, ſtrong Fire being often repeated, it retains this Property.

6. It therefore does not depend upon a foreign Impurity of the Quickſilver, ſeparable from it by Fire.

7. The Matter remaining in the Bottom of the Retort, from the Diſtillation of the Quickſilver, is red, ſhining, acrid, and no more like the black, ariſing from Concuſſion, than that Part which continued volatile.

8. Quickſilver is turned red by Fire, and black by ſhaking: It is therefore changeable in it's Colour.

9. Does it yield more black, if wrought upon in a leſs Quantity?

Exp. 3. The black Powder (*Op.* 2) being raiſed with a ſtrong Fire from a Glaſs Retort, returns to pure Quickſilver.

Operation. I raiſed ℥ij Gr. xxvj of the black Powder (*Op.* 2) with a ſtrong, open Fire, from a clean Glaſs Retort, ſo that the Retort was hot for 2 Hours.

Effect. There were in the Receiver ℥ij Gr. ij of a moſt pure, inſipid, ſhining Quickſilver. There ſtuck here and there to the Sides of the Glaſs a ſmall Quantity of Quickſilver, which I could not get up exactly. At the Bottom of the Retort there was a ſmall, thin, fixed Spot, barely viſible.

Coroll. 1.

Coroll. 1. Quickſilver 61 Times diſtilled, ſhaken, and turned into the above-mentioned Powder, returns by Fire alone to it's ancient Form.

2. From acrid and penetrating, it becomes very mild.

3. From being very black, it becomes bright and poliſhed.

4. From a conſiſtent Powder, it becomes very fluid.

5. After theſe 3 Operations, it remains the ſame, though it changes into various Shapes.

6. The acrid Power and Taſte are wonderfully changed therein, by Motion alone, and by Fire alone.

7. In the mean Time there proceeds ſome little of fixed from the Quickſilver, by theſe Operations.

8. The black Subſtance was no Impurity, nor any Thing foreign, ſo ſeparated from the Quickſilver.

Scholium. I put Quickſilver in conical Glaſs Cucurbits, with a plain Bottom, cloſed with an inverted, chemical, Glaſs Phial, and expoſed it to a Fire of 180 Degrees for ſeveral Months. It became black, and afforded a black Powder, alike in every Reſpect. Hence I learned, that Fire and Shaking have the ſame Effect upon Quickſilver in this Degree.

Exp. 4. Quickſilver is changed by ſimple Diſtillation.

Operation. I diſtilled ℥xviij *Amſterdam* Weight of Quickſilver, bought of the *Amſterdam* Company, from a clean Glaſs Retort, with a Sand-Heat, into a Receiver filled with the cleareſt Water to the Height of 4 Inches, till none of the running Quickſilver remained in the Belly of the Veſſel. I dried and purified the Quickſilver in clean, dry, filtring Paper: So that it might be perfectly dry, and clear from any accidental Impurity, and from the black, which comes over with the Quickſilver at every Diſtillation. Then I poured it into the ſame Retort, and diſtilled it again as before. I repeated the Operation 52 Times. At each Diſtillation there roſe a red, ſhining Powder in the Retort.

Effect. A ſharp, red, ſhining Powder, purging upwards and downwards, to the Quantity of ℥iv℔ß. The remaining Quickſilver weighed ℥xvj ℥v. Therefore ℥vj℔ß were loſt. This could not be avoided: For ſomething gets out through the Lute; and ſomething black and a ſmall Quantity of Quickſilver ſtick to the filtring Paper at every Exiccation. There is but a little loſt in each Operation; but this being multiplied, amounts to a good deal. The Powder obtained was heavy, of a ſhining red Colour, very friable, of a very ſharp, metallic, nauſeous, penetrating Taſte, hardly to be got out of the Mouth, diſturbing the human Body long and much, and diſpoſing it to Excretions. The Quickſilver thus obtained ſeemed more fluid than the common.

Coroll. 1. Quickſilver thus acted upon by the Fire, is changed near $\frac{1}{28}$ of it's Weight from a Fluid to a Powder.

2. From a ſhining Silver Colour to a ſhining red Colour.

3. From

3. From a moſt inſipid Taſte, to a moſt ſharp, horrid, metallic, penetrating Taſte.

4. From being moſt mild, to a virulent, venemous acrid, diſordering the Body, and cauſing Pain.

5. From volatile to more fixed, being no longer volatile with the ſame Degree of Fire that firſt brought it over.

6. The remaining Part becomes more fluid, the other ſimilar.

7. Mechanical Motion and a ſmall Fire give a black Colour to Quickſilver; a ſtronger Fire, with the Veſſel ſhut, makes it red.

Exp. 5. I was deſirous to know, what farther would happen to the Quickſilver, if it was urged by a Fire requiſite to Diſtillation.

Operation. I diſtilled as before ℥xv ℥v of the Quickſilver remaining from *Operat.* 4, till nothing remained at the Bottom. When it was come out, I depurated and dried it, and always poured it again into the ſame Retort. I repeated this Operation 448 Times. The Quickſilver was now diſtilled full 500 Times. It always generated ſomething red: It always roſe more fluid and more pure. The laſt Times I made the Fire ſtronger, and then the red Powder ſeemed to be rather diminiſhed than increaſed; perhaps being partly revivified.

Effect. The Powder at the Bottom of the Retort weighed ℥j ℥v Gr. xxi: The Quickſilver remaining after 500 Diſtillations weighed ℥ix ℥v: But in ſo many Diſtillations the Retorts happened ſometimes to crack, and ſo ſome of the Quickſilver eſcaped, beſides what was loſt by ſo many Times purging and drying.

Coroll. 1. The Corollaries of *Oper.* 2 and 4 are verified alſo in this Operation.

2. Quickſilver is very immutable in one Part.

3. But very mutable in another.

4. Perhaps it returns from it's changed Form to it's firſt Appearance.

5. And perhaps regenerating by a new Action of the Fire, it is again revolved to it's changed Form.

Exp. 6. The Property of Quickſilver, which turns it by Fire to this Powder, is hardly taken away from it by Diſtillation.

Operation. I diſtilled in a clean Glaſs Retort the moſt fluid, pure Quickſilver, remaining in the Weight of ℥x ℥vſs, having made from it, by 501 Diſtillations, ℥ij ℥j Gr. lj; ſo that all the Quickſilver paſſed over entirely into the Receiver. The Bottom of the Retort was as clean as if juſt taken out of the Furnace. But at the Edge of the Surface, where it had ſtood before Diſtillation in the Belly of the Retort, there was a thin, beautiful, fine red, ſhining Ring. When the Quickſilver was come over, I dried and purified it, and poured it again into the ſame Retort. I brought it over into the Receiver, and repeated the Operation 10 Times. At each Time there was made more of that red Powder; and that in no leſs Quantity than from the crude Quickſilver.

Effect.

Effect. A moſt ſhining vivid Quickſilver. A fine red, fixed Powder. The reſt (as 2, 4, and 5) to Gr. vij.

Coroll. 1. The Mutability of Quickſilver into this Powder by Fire remains in it, after $\frac{1}{8}$ of it is turned to Powder.

2. It remains after 511 Diſtillations, each of which made ſome of that Powder, though no new Quickſilver was added.

3. That Powder therefore is hardly to be accounted an Impurity ſeparable from the *Nucleus* of Quickſilver by Diſtillation.

4. Hence it is manifeſt, that it is thus changed by theſe Means; but it is not certain, that it is thus defecated.

5. Fire is not ſo united with Quickſilver, as the modern Chemiſts have aſſerted.

6. Diligence hardly teaches a conſtant Artiſt the Bounds, beyond which that Powder is no longer made.

7. If that Powder ariſes by Fire from the crude Sulphur of Quickſilver: This Diſtillation does not purge the Quickſilver from it.

Exp. 7. To examine the Powder produced by *Oper.* 2, 4, 5, and 6.

Operation. I put ℥ij ℥j Gr. lj of that Powder into a clean Glaſs Retort, covered with a Cruſt of Clay tempered with Sand; I urged it by Degrees, till the Retort, ſet upon the naked Fire, grew hot with Plenty of Fire laid over it, in a Sand Furnace, for 3 Hours together.

Effect. There came out ℥j ℥ſs of pure, revivified Quickſilver from that Powder: At the Bottom of the Retort there remained ℥vijſs of bright red Powder. Something ſtuck in the Neck of the Retort, and in the Glaſs Veſſel applied to it's Neck. Something perhaps was diſſipated by ſo large and long a Fire.

Coroll. 1. Quickſilver returns from the Powder, into which it had been converted by Fire.

2. Being revivified, it recovers all it's former Properties, and loſes thoſe it had acquired. Quickſilver comes the ſame from the Powder.

3. The acquired Fixedneſs does not bear a great Fire.

4. But there is one Part in that Powder more fixed than the other: The latter ſtill remains in the Form of Powder; the former returns into Quickſilver.

Exp. 8. To examine farther the Powder remaining from the preceding Operation.

Operation. I put ℥vij Gr. xxxvij of that Powder into a very clean Glaſs Retort, covered with a Coat of Clay and Sand, and committed it to a naked Fire, increaſed cautiouſly by Degrees; till at laſt the Retort being covered all round with Fire, grew quite hot. I kept it thus ignited 4 Hours.

Effect. The Quickſilver revivified from this Powder, came over very pure to the full Quantity of ℥vij. At the Bottom of the Retort there were Gr. xv of a brown ſubtile Powder, fixed in ſo great and continued a Fire. There was a very thin broad Spot, of a very fine red Colour,

impreſſed on the Bottom of the Retort, and, as it were, penetrating into the Glaſs.

Coroll. 1. Quickſilver is changed to the above-deſcribed Powder (2, 4, 5, 6, 7, 8) by Fire alone.

2. This Powder is turned to Quickſilver by Fire alone, only greater.

3. Thus a Serpent bites itſelf and dies.

4. It riſes again more glorious after Death.

5. So long Labour, and ſo great a Fire being ſo long ſuſtained, out of ℥xvij of Quickſilver there remained only Gr. xv fixed, in a Glaſs ſo hot, as to be almoſt melted.

6. Silver, Gold, and other Metals, ſought by this Art in Quickſilver, are hardly any Thing in Proportion to the Expence and Labour.

7. Only $\frac{1}{72}$ Part of the Powder thus fixed from Quickſilver remains fixed in this Fire: The reſt returns to Quickſilver.

8. Are the loſt Gr. xxij diſperſed? Or is that Weight added by the Fire to the Quickſilver, and ſeparated from it again by a greater Fire?

9. The Nature of Quickſilver is conſtant, ſimple, and not ſeparable into diſſimilar Parts by Diſtillation. Neither into fixed and volatile; nor into pure and impure; nor into impure and purified; nor into different Elements.

Exp. 9. I put Gr. xiij of this laſt fixed Powder, in a Crucible, upon an open Fire before the Bellows. I blowed the Fire till the whole Crucible was totally ignited. I kept it ſo for $\frac{1}{4}$ of an Hour. The Powder remained fixed at the Bottom, but ſwoln like a Spunge and brown: Hence I learned, that the great Fixedneſs of this Powder is acquired by the Fire alone.

Exp. 10. I added, in the Crucible, a little Borax to this ſo fixed Powder, and blowed the Fire. It became one, friable, vitreſcent Maſs, fixed in this great Fire.

Exp. 11. I gave Gr. ij of that Powder, which had remained ſo fixed (8) to the Weight of Gr. xv, to a moſt ſkilful, ſworn Aſſayer at *Amſterdam*, to examine it in the moſt accurate Manner with Lead, according to the Rules of Art. There remained nothing fixed at all. Therefore there is not any Gold or Silver in that Powder.

Exp. 12. Thoſe Gr. xiij, melted into a vitreſcent Maſs with Borax, were given together with Borax to a moſt ſkilful, ſworn Aſſayer of *Amſterdam*, to examine, according to the Rules of Art, in Lead, with the greateſt Accuracy. There remained nothing fixed from the whole Maſs; and, conſequently, nothing of Gold or Silver.

Coroll. 1. Quickſilver continues in the Fire, retaining it's immutable Nature.

2. It is ſimple, and not ſeparable by Diſtillation into diverſe Bodies.

3. It is fixed by the Fire, and ſeems changed in it's external Form.

4. Appearing thus, in various Parts, it acquires different Degrees of Fixedneſs.

5. But

5. But not one of theſe Parts acquired the Fixedneſs of Gold, or Silver, by ſo long and continual a Fire.

6. The fixing Cauſe is the Fire paſſing through the Glaſs, and ſo changing Part of the Quickſilver, either by mere Action, or by uniting itſelf with the Quickſilver.

7. That Fire thus acting, through 511 Diſtillations, was not able, either by it's own Power, or by Conjunction, to change even the leaſt Particle of it into Gold or Silver.

8. But from Quickſilver, thus fixed by the Fire, a greater Fire reſtores true Quickſilver; or the known Force of Lead makes it vaniſh from the Cupel.

9. It does not appear therefore, by theſe Experiments, that any known Metal is produced by Quickſilver and Fire, thus conſpiring together: Thoſe Gr. xiij did flow when the Fire was blown; they did not ſtand in Lead; they were not diſſolved with the Quickſilver into an Amalgama.

10. By theſe Experiments therefore Fire is not demonſtrated to be the Sulphur of the Philoſophers, fixing Quickſilver into Metals.

11. It is probable, however, that the Sulphur of the Philoſophers is ſomething very near it.

12. The fixed Part is not the Dreg of Quickſilver; nor it's crude, fetid Sulphur: It returns to it again.

13. The Depuration of Quickſilver from it's terreſtrial Impurity, and aqueous Crudity, ſcarce ſeems to be ſo eaſy to be obtained from it by mere Diſtillation: Perhaps it is obtained by ſome more ſecret Operation.

14. Neither Gold nor Silver is made from Quickſilver by Fire. The Ignorant, and thoſe who are given up to Imagination, are eaſy in Promiſes, and rich in Hope. Here Quickſilver remained Quickſilver.

15. We are ſafe from the fallacious Writings and Preſcriptions of the Sophiſts, who promiſe to make ſuch Things from Quickſilver in the ſhort Space of a few Months: For in ſeveral Years there do not appear the leaſt Signs of a firſt Beginning.

Exp. 13. Quickſilver detained under boiling Water, is not elevated from the Bottom of the Veſſel.

Operation. I poured ℥j of pure Quickſilver into a Glaſs Urinal, which I filled with Rain-Water. I then ſet the Veſſel upon a naked Fire. The Water boiled ſtrongly for 8 Hours: But ſo that ſome Water always ſwam above the Quickſilver. Then the Quickſilver being weighed, was juſt ℥j, without any Loſs.

I poured the Dram of Quickſilver again into a clean, dry, Glaſs Veſſel. I fitted it within a Kettle, ſo that it could not ſtir. I filled the Kettle with Water, and took Care to make it boil for 8 Hours. This Veſſel was cylindrical, open, 2 ½ Inches deep, and ſo placed, that the Water could not get into it. This being done, the Quickſilver weighed ℥j, without any Loſs.

I put pure Quickſilver into a Glaſs Cucurbit, and poured Water upon it; and ſetting it on an Alembic, boiled it a long Time, but none of the Quickſilver roſe. I continued the Boiling till all the Water was driven away, and the Quickſilver remained dry at the Bottom of the Veſſel, the Fire not being then increaſed. The Quickſilver preſently roſe to the Sides of the Cucurbit, and into the Capital: The Reaſon appears from what I have written in my Chemical Inſtitutions concerning Water and Fire.

Exp. 14. Quickſilver may be changed by Art, ſo as to riſe from the Bottom of the Veſſel, by the Heat of Vinegar, before it boils.

Operation. I ſhook an Amalgama made of half a Pound of Lead, and 1 ½ Pound of Quickſilver in a Glaſs. It became a very black Powder. I put it into a Glaſs Cucurbit, 14 Inches deep, and poured upon it diſtilled Wine-Vinegar, made very pure by double Diſtillation. I took off the Phlegm by a gentle Diſtillation: Then I increaſed the Fire a little; but ſo that the Liquor did not boil at all. The Quickſilver roſe into the Capital, together with the Phlegm, and from thence into the Receiver. I tried the ſame Thing other Ways: A Thing worthy of Speculation! of which I ſhall ſay no more at preſent. By a like Artifice I ſaw Quickſilver rendered ſo volatile, as to riſe in my digeſting Furnace, by a leſs Heat than that of a healthy Man, aſcending along the Sides of the Veſſel. Do you think it was then more pure? It was mixed with Metal, and very dry.

Exp. 15. *Geber* has written, that pure Quickſilver is heavier than Gold. I tried a long Time to learn whether it could be made more denſe, and therefore more heavy than it is naturally. I began to attempt it by ſeparating it's lighter and more mutable Part, from the more ponderous Remainder, but could not. I afterwards endeavoured various Ways to defecate it; but it did not ſucceed. I found however ſome Things worthy of Obſervation. Examining a Maſs of ℥ij of the pureſt Gold hydroſtatically in Rain-Water, defecated by a gentle Diſtillation, I found the Weight of it to be to Water as $19\frac{119}{500}$ to 1. The Quickſilver commonly ſold, once diſtilled by a Retort, is to the ſame Water as $13\frac{57}{100}$ to 1. Quickſilver worked up with the pureſt Gold, and diſtilled ſome hundred Times, was to Water as $13\frac{55}{100}$ to 1. Quickſilver thus treated with the pureſt Silver, was to Water as $13\frac{58}{100}$ to 1. Quickſilver united with Lead, wholly turned into a Powder with it, and reſuſcitated by a ſtrong Fire, was to Water as $13\frac{55}{100}$ to 1. Quickſilver diſtilled 511 Times, was to Water as $14\frac{11}{100}$ to 1. Theſe Statical Weighings were made with exact Inſtruments, and the ſtricteſt Caution. I ſpent ſeveral Years in preparing Quickſilver for this Purpoſe. Nor do I know, that any one elſe has had regard to it. Many Corollaries might hence be drawn by proper Judges with mature Conſideration. I ſhall mention a few.

1. If

1. If defecated Quickſilver becomes lighter, then it is rendered moſt defecated by Gold and Lead. By the Art of *Suchtenius* and *Philalethes*, it remains the ſame.

2. If defecated Quickſilver becomes heavier, then it is rendered moſt defecated by Silver, in Proportion to other Metals. But moſt of all by ſimple Diſtillation, by Converſion into red Precipitate, and Reſuſcitation therefrom.

3. Quickſilver may be rendered more denſe by Silver and Fire.

4. Quickſilver may be rendered more denſe by Fire, and moſt by Diſtillation. Is not this therefore the beſt Way to purify and perfect it?

5. Does Quickſilver depoſit it's heavieſt Part in Gold? Is this the Seed of Gold?

6. Does Quickſilver depoſit it's heavieſt Part in Lead? Is this the Seed of Gold?

7. Does Fire, boiling Quickſilver 511 Times, fixing, and reſuſcitating it, increaſe it's heavieſt Part? How far can that be done? Can Quickſilver, by continuing the Operation, at laſt be condenſed into the Weight of Gold? Would it then be quick Gold, or *Mercurius Philoſophorum?* Let proper Judges examine.

2. *Exp.* 1. Pure Quickſilver, ſuch as is commonly ſold by the *Amſterdam* Company, digeſted a long Time upon the Fire, is not changed to a Metal. Part II. No. 443. *p.* 343. Oct. 1736.

Operation. This Quickſilver being diſtilled, left no Dreg. Afterwards being mixed with diſtilled Vinegar and Sea-Salt, and agitated for a long Time, it remained pure. I ſtrained it through Leather, and put a Pound of it into a Matraſs with a long Neck, the Mouth of which I ſtopped with a Paper Cone, and covered it with another Paper well tied to the Neck of the Matraſs, ſo that no Duſt could get into it, and at the ſame Time the Air could eaſily get in and out. I placed it in a Furnace with a continual Heat, which, by M. *Fahrenheit*'s Thermometer, kept at above 100 Degrees of Heat from *Nov.* 15, 1718, to *May* 23, 1734. Then I found the Quickſilver fluid in this Matraſs, with a little black Duſt upon the Surface. This Powder being rubbed in a Mortar, revivified into Quickſilver. I put all this Quickſilver in Diſtillation in a clean Glaſs Retort, increaſing the Fire toward the End, till the Retort was almoſt red-hot. There remained nothing at all in the Retort, and the Quickſilver came out without any ſenſible Alteration.

Coroll. 1. Fire to the Degree, and during the Time above-mentioned, changes nothing of the Fluidity, Volatility, or Nature of the Quickſilver put into a Veſſel, where the Air comes freely: Nor is there any Separation made between the pure and impure.

2. Nor is there any ſenſible Generation of the leaſt Quantity of Metal.

3. Much leſs of Silver or Gold.

4. Nothing

4. Nothing of the Quickſilver was fixed by this Operation, continued for 15 ½ Years; nor did there appear the leaſt Beginning of metallic Fixation, not even of Lead; which however, according to thoſe who boaſt of knowing this beſt, ought to be the firſt Metal formed by this Operation.

5. This Experiment by no Means favours the Opinion of thoſe, who affirm that Metals are formed from Quickſilver, as the Matter, and from Fire as the fixing Sulphur, united by Digeſtion.

6. It is very probable, that all ſimilar Operations made with pure common Quickſilver, do by no Means anſwer to what is promiſed from them, ſince the ſmall Quantity of black Powder already mentioned is lighter than the Quickſilver, on the Surface of which it ſwims, and very eaſily becomes Quickſilver again: See what was ſaid in the preceding Article concerning a like black Powder obtained from Quickſilver by Motion only.

7. It does not appear, that Quickſilver can be changed in the Mines into any metallic Thing whatſoever, by the ſole Action of the ſubterraneous Fire acting for a long Time, and in a Place to which the Air has a free Acceſs: For Heat does not riſe to above 70°, in Places where Veins of Metals are found. They ſay indeed, that 1000 Years are required to produce this Effect; but how can Men, who live ſo ſhort a Time, be ſure of this?

8. As to Sulphur, which the Alchemiſts have believed to be one of the Principles of Metals, and of which they ſay, that it unites the Elements of Quickſilver, in order to make a ſolid Body, and fixed to a Degree of Fire capable of rendering it fuſible and malleable; this Sulphur, I ſay, ſeems to be quite different from the Matter of Light or Fire, though Fire alone is the only Means of producing this wonderful Union of this Sulphur with Quickſilver.

However in this Operation the Air was admitted freely to the Quickſilver, and it may be ſaid, perhaps, that this is the very Thing that hinders this Action of the Fire; and the more, becauſe the Alchemiſts ſay, that crude Air hinders the Philoſophical Coction: This induced me to make the following Experiment.

Exp. 2. Quickſilver put in Digeſtion in a cloſe ſtopped Veſſel, during the Time mentioned below, does not produce any Metal.

Operation. I put pure Quickſilver into a conical Glaſs Veſſel with a flat Bottom, ſuch as the Aſſayers uſe in ſeparating Gold and Silver, and expoſed it to a Heat of 100 Degrees from *Dec.* 6, 1732, to *July* 8, 1733. The Veſſel being conſtantly ſtopped, the Quickſilver did not undergo any remarkable Alteration; I put ℥vj of it into a Veſſel like the former, and inſerted the Neck of an inverted Phial into it's Mouth, without luting the 2 Veſſels together; I expoſed it 4 Days to a Sand-Heat ſo ſtrong, that the Quickſilver began to riſe, and this with an Intent to drive out any Moiſture that might be lodged therein. When I ſaw that there was not the leaſt Sign of Humidity, I luted the Place exactly,

exactly, where the 2 Veſſels joined. I expoſed the Quickſilver to a Sand-Heat, ſtrong enough to riſe and fall gently; I continued this Degree of Heat till *Jan.* 29, 1734: I found nothing at the Bottom of the Veſſel but fluid Quickſilver, lightly covered with a fine, light, ſubtile, black Powder, nothing fixed, nothing precipitated, though the Degree of Heat was always near to that of boiling Water. Then I poured this through a very dry, clean, Paper Funnel, the lower Orifice of which would hardly ſuffer a Hair to paſs. The Quickſilver came very clean through that little Hole, and there remained about the Sides, and about the Hole of the Funnel, a ſmall Quantity of a black Subſtance, which being rubbed in a Mortar, turned again to Quickſilver. I diſtilled this Quickſilver thus depurated in a Glaſs Retort, with a Sand-Heat, and toward the End, with a Fire of Suppreſſion; there remained nothing fixed at the Bottom of the Retort, the Quickſilver ſeemed a little more fluid than before, but not at all changed otherwiſe.

Coroll. The ſame Concluſions may be drawn from this as from the preceding Experiment; and if they are added to what I mentioned in the former Paper, it will plainly appear, that Quickſiver is immutable in it's own Nature by mechanical Motions, and by the above-mentioned Diſtillations and Digeſtions. From all this I conclude, that the Chemiſts may ſave themſelves the vain Labour of repeating all theſe Operations, with an Intent to fix Quickſilver, or to change it into any other Body than what it is; I adviſe them alſo not to give Credit to ignorant Perſons, abounding in vain Promiſes, among whom thoſe are leſs to be blamed, who endeavour to try Experiments at the Expence of others.

I have laboured a long Time to know certainly, whether it is true, that Metals can be reſolved by Art into Quickſilver, and into any other Principle; many Authors affirm it ſo diſtinctly, and in ſo many Places, that there ſeemed to be no Room to doubt of the Fact: I believed it upon the Credit of theſe Authors; but in order to be convinced of it by my own Eyes, I went to work upon Lead. The famous *Van Helmont* * ſays, "Lead, becauſe of the Crudity of it's metallic Nature, "ſuch as ſometimes Fire alone can deſtroy, may alſo, by the groſs "Parts of the fixed Salts, be divided into the Principles of which it is "compounded, ſo as to ſuffer the crude Quickſilver to run." His Son *Francis-Mercury Van Helmont* † ſays, "When Lead is diſſolved "by Alkalies, and Salts, or Oil, which take in the Sulphur, and ſepa-"rate it from the Body, the Lead by this Means becomes changed into "a volatile running Mercury, which can no more endure the Fire, as "before, but is cold and running like Water, and without a metalline "Form." *Joachim Becherus* affirms the ſame Thing, and anſwers for the Succeſs of ſeveral Operations which he deſcribes for this Purpoſe,

* *Poteſt. Medicam.* §. xl. † Paradoxical Diſcourſes, Part ii. §. xxii.

in

in his *Collectanea quingentorum Experimentorum*, from *p.* 310 to 333. Here follows in few Words what I have learned on this Subject, by a very long and tedious Labour.

Operation. I diſſolved as much pure Ceruſe, as could be diſſolved, in Spirit of Nitre diluted with 6 Times it's Weight of Water; and filtred this Solution, which was very clear. This Liquor being put into a very clean Glaſs Veſſel, and thickened by a gentle Heat, and afterwards being ſuffered to reſt in a cool Place, there were formed Cryſtals in it, of which I took ℥xiv, and reduced them to Powder in a Glaſs Mortar with a Glaſs Peſtle. I diſſolved this Powder in very pure Rain-Water, and diluted this Solution with 3 Times as much Rain-Water; and then I poured gently and carefully another filtred and very clear Solution made with Sal Ammoniac and Rain-Water. The Mixture became as white as Milk, and the Lead precipitated immediately, as it happens to Silver diſſolved in *Aqua fortis*, as ſoon as Sal Ammoniac is mixed with it. The precipitated Powder, which was as white as Snow, being waſhed in a great deal of Water, and then dried, was very inſipid, and weighed ℥xviijſ℈. I put ℥vj of this white, dry Powder into a very clean Glaſs Urinal, and poured to the Height of 2 Fingers over this Powder a very ſtrong Lee, compoſed of quick Lime and Pot-Aſhes, which I kept ſeveral Years in a cloſe-ſtopped Bottle. Afterwards I covered the Urinal with filtring Paper tied well about the Neck, and ſet in a Furnace of Putrefaction in a Heat of 96 Degrees. I left it there from *Feb.* 6, 1732, to *Aug.* 13 following, to try whether this Mixture, being expoſed to the Air, would be altered by this Heat of Putrefaction. I found nothing but a white Maſs, which being reduced to Powder, taſted of Salt. I put it into a Glaſs Retort, covered with a Lute compoſed of Clay and Sand; and urged it with an open Fire till it became red-hot, and continued it 3 Hours in the ſame State. There aroſe ſome white Soot in the Neck of the Retort, but no Quickſilver at all, and at the Bottom there remained a half vitrified brittle Matter, of an Aſh-Colour. I reduced it again to a Powder of the ſame Colour, which I beat a long Time in a Mortar, with a Lee of fixed alkaline Salt and quick Lime, and dried it again by a ſlow Fire; I poured freſh Alkali upon it, and expoſed it to a Heat of 96° from *Aug.* 18, 1732, to *Oct.* 15, 1733, beating it every Day in the Glaſs Mortar, in which it was, which was covered only with Paper, ſo that the Air had free Acceſs. It was then a dry, white, acrid Powder, on which I poured ſome more Lee, and reduced it to a Paſte. I ſet it in Putrefaction as before, beating it often from the Day above-mentioned till *Feb.* 21, 1734; then it became a white, ſaline Maſs, very near approaching to the Taſte of Sea-Salt. After it was beaten and waſhed with Water, and dried very ſlowly, I found a very inſipid, white Powder. I put it into a Retort, which I kept ſeveral Hours in the greateſt Fire that the luted Glaſs could bear. *May* 20, 1734, no Quickſilver came out; the Neck of the Retort was ſtained of ſeveral Colours; the

the friable Maſs, which remained at the Bottom, afforded alſo different Colours, diſpoſed in *Strata*, and weighed ℥v ℥vjſ℈; the Powder into which it was reduced by beating, was of a reddiſh grey Colour.

Scholium. In this Operation, the Lead at firſt was ceruſe, that is penetrated and diſſolved by the Vapour of the Vinegar, reduced to a white *Calx*, and then to a ſubtile Powder. It was then diſſolved in diluted Spirit of Nitre, and ſo became a very clear Liquor, without Colour, and of a ſweet Taſte, in which the Lead was reduced and divided into moſt minute Parts. *Thirdly*, The diſſolved Sal Ammoniac poured on, by expelling the Spirit of Nitre, ſubſtituted in it's Place a Spirit of Sea-Salt, and uniting itſelf intimately with the metallic Part of the Lead, diſpoſed it, as much as poſſible, to facilitate the Separation of the Quickſilver from the metallic Part, according to the Opinion of all thoſe who ſeem to have written beſt on theſe Subjects: For they aſcribe the Power of ſeparating Quickſilver from Metals principally to Sal Ammoniac and Sea-Salt. *Fourthly*, The Lime thus prepared, and put in Digeſtion 7 Months, with a very violent Alkali, ſeemed likely to make the Quickſilver appear, by abſorbing the Sulphur of the Lead. But however, though a ſtrong Fire was applied, yet it did not afford the leaſt Quantity of Quickſilver. *Fifthly*, This Maſs being ſtrongly beaten for a long Time, and then mixed with a new and very ſtrong Alkali, and digeſted for 14 Months, ſhewed not the leaſt Appearance of Quickſilver. *Sixthly*, It was pounded again with new Alkali, and digeſted for 5 Months; ſo that after all theſe Operations, it was ſufficiently expoſed to the Action of the Alkali, to have Time to ſeparate the ſulphureous Part of the Lead, and for the Quickſilver, being diſengaged from this Sulphur, to be driven out by the Force of the Fire. Nevertheleſs, after all this Labour, the very greateſt Fire did not diſcover any Quickſilver.

It is plain therefore, that what Authors have boldly pronounced, concerning the Facility of extracting Quickſilver from Lead, is not confirmed by Experience. Lead, ſay thoſe Authors, is the Metal that contains the moſt of Quickſilver, and is reſolved moſt eaſily into Quickſilver by reſuſcitating Salts. Therefore it is more difficult in other Metals. Authors affirm, however, that it may eaſily be done, and preſcribe Methods very little different from that which I have now related, by which I have learned, after all my Labours, that what they have promiſed, will not ſucceed. I very much queſtion, whether the Aſſertions of theſe Authors are founded upon Obſervations. I rather believe, that they gave Way to their own Opinions, than conſulted Experience. What has now been related, will ſerve at leaſt to ſave the Reader the Trouble and Expence of repeating theſe Obſervations, and to hinder him from admitting eaſily theſe pretended Principles of metallic Knowledge.

Exp. 3. *Iſaacus Holland* has written, that Quickſilver may eaſily be extracted from the Salt of Lead, made with diſtilled Vinegar: To

make the Experiment, I prepared ſome Sugar of Lead with the beſt Litharge, and ſome diſtilled Wine-Vinegar: I calcined ℥ij of it in an open Glaſs Veſſel, with a ſlow Fire, continued from *June* 6, 1734, to *July* 19 following. The white Powder thereby produced, was beaten very fine in a Glaſs Mortar with a Glaſs Peſtle. It was beaten very quick and long, adding now and then ſome Lee, ſaturated with as much of a moſt violent fixed Salt as the Water could diſſolve. I kept it in the ſame Mortar, covered with Paper, in a Heat continued from *July* 21, to *Nov.* 27. During this Time I took Care, as ſoon as the Powder was dry, to beat it again with freſh Lee. I kept it all that Time covered with Paper, in a Heat of 90 Degrees, drying, moiſtening, and pounding it alternately. The laſt Day I beat this white dry Subſtance into an impalpable Powder; and having put it into a luted Glaſs Retort, I carefully increaſed the Fire by Degrees, till the Retort was red-hot, and kept it in this State for 4 Hours. There did not appear even the ſmalleſt Globule of Quickſilver, either in the Receiver, or in the Neck of the Retort, at the Bottom of which there was found a very black, light Maſs, in Form of Powder, of a burning alkaline Taſte. *Nov.* 28, I ſet it on a Glaſs Plate in a Cellar, where it preſently grew moiſt, and left it there till *Jan.* 8, 1735. This Subſtance was then increaſed in Bulk, all the ſaline Part being turned to Liquor by the Moiſture of the Air, and the metallic Part being at the Bottom in Form of a black Powder. I dried it all together, both that which was melted, and that which was not; and this Mixture was very black. I put it again into a Glaſs Retort, and at laſt raiſed the Fire till it kept it red-hot for 4 Hours. There did not even now appear the leaſt Sign of Quickſilver, either in the Receiver or Retort, at the Bottom of which there remained a grey Subſtance, of a hot fiery Taſte, which immediately turned to Liquor, on being expoſed to the Air.

In this Operation the Lead being diſſolved and opened by pure Vinegar, and diſpoſed ſo that it might be intimately penetrated by the Salt; being mixed and pounded with a liquid, cauſtic, fixed Alkali; being put in Digeſtion, put in Putrefaction, and expoſed to a violent Fire; being diſſolved by the Moiſture of the Air during a Philoſophical Month; laſtly, being pounded, dried, and raiſed by a violent Heat, did not afford even the minuteſt Quantity of Quickſilver.

What are we to think now of this Matter, or of what has been advanced ſo boldly by idle, credulous Men, given up wholly to Speculation? They engage thoſe who have more Application to Labour than Knowledge, in vain Labours and exceſſive Expences, and thereby render one of the fineſt Arts odious. Let others reap the Profit of my Labour and Expence, and ſpare their own.

Exp. 4. Having learned, by my own Experience, that the Salts called reſuſcitating, could not extract any Quickſilver from Lead by the Method juſt deſcribed, I was willing to try what Quickſilver itſelf could produce in this Caſe; eſpecially as the Chemiſts call this Fluid the

Water

Water of Metals, in which they tell us Metals die and riſe again, and become more beautiful than they were before. I melted ℥j of Lead in a very clean Iron Spoon, and at the ſame Time heated ℥iij of pure Quickſilver in a like Spoon. I then poured the hot Quickſilver upon the melted Lead; they mixed immediately, and formed a ſolid Maſs, of a Silver Colour. I beat it, and when I had made it ſoft, I put it into a ſmall warm Matraſs, which I ſtopped with a Cork, and placed in a digeſting Furnace, in a Heat always equal to 84 Degrees, from *Feb.* 11, 1732, to *Jan.* 10, 1735. It was a ſoft Amalgama, yielding to the Peſtle like Butter, growing black immediately on being ſhaken, and weighing ℥iv. The ſame Day I expoſed it to a Sand-Heat in a clean Glaſs Retort, and at laſt to a Fire of Suppreſſion, till the Sand was quite red, and that for 4 Hours; there came over ℥ij ℈vjſs of Quickſilver into the Receiver. There was at the Bottom, and in the Neck of the Retort, a red Powder, formed by the Quickſilver in diſtilling, there was a little Quickſilver in the Neck, and ſome Globules of pure Lead in Form of Powder; the whole weighed Gr. lii. Laſtly, there was at the Bottom a ſolid Maſs of Lead weighing ℥j wanting Gr. v, which made up the Value of the Globules of Lead; whence it appeared, that all the Lead remained, and that Gr. xliii of the Quickſilver were diſſipated. Thoſe who have any Knowledge in theſe Affairs, will eaſily find the Cauſe of this Diſſipation in the Cauſes already mentioned, eſpecially if they conſider, that in diſtilling, Part of this Quickſilver remains faſtened to the extended Surface of a great Receiver; and that another Part remains in Form of little Clouds on the Surface of the Water, which muſt always be put into the Receiver.

By this Operation I learned, that no Quickſilver could be extracted from Lead, by a Digeſtion of the Quickſilver with the Lead, continued for 3 Years, and by a moſt violent Diſtillation; alſo that Quickſilver cannot by theſe Means be fixed in Lead: Becauſe in the Diſtillation of Quickſilver, there is always a ſmall Quantity of it changed to a red Powder, which is fixed in the Fire in this Application; but the Weight of the Lead always remained the ſame.

Exp. 5. I performed the ſame Operation on an Amalgama made with ℥iij of Quickſilver, and ℥j of good Tin, and expoſed them to the ſame Degree of Heat during the ſame Time. Then I diſtilled them in the ſame Manner in a Glaſs Retort by the ſame Fire. I got from the Receiver ℥ij ℥iv of Quickſilver; at the Bottom of the Retort there was a Powder, Part of which was fine, and compoſed of a ſmall Quantity of fixed Quickſilver; and the other groſſer Part was black, and compoſed of ſmall Parts like Tin. There was ſtill a little Quickſilver at the Bottom of the Neck of the Retort. All together weighed ℥ij Gr. v. At the Bottom was a ſolid Maſs of Tin, weighing ℥j ℥j Gr. ix. The Loſs was Gr. xlvi, of which I have given the Reaſon already.

It appears by this Operation, that Quickſilver cannot be extracted from Tin; but ℥iij Gr. xiv, that is, about $\frac{1}{7}$ of the Quickſilver were

united with the Tin, and ſo well fixed as not to be ſeparated by a Fire that made the Sand red-hot, continued 4 Hours. There is a great Connection between *Jupiter* and *Mercury*, and *Sol* is in the middle between them *.

Exp. 6. I heated ℥x of Quickſilver, and poured it upon ℥ij of very good Tin, melted in a very clean Iron Spoon. I beat the whole into an uniform Amalgama, which being very hot and dry, I put into a clean, warm Glaſs Blottle, which I afterwards ſtopped. I placed it in a wooden Box, which I faſtened to the Hammer of a Fuller's Mill, continually at work; and there it remained almoſt in continual Motion Night and Day from *Nov.* 30, 1732, to *Jan.* 9, 1735. Then I took out the Bottle, which was whole, and found fluid Quickſilver at the Bottom; and after a Reſt of ſome Days, there was found a pretty hard Amalgama at the Top; the whole weighed exactly ℥xij. I diſtilled ℥xj ℥vij of this Amalgama in a luted Glaſs Retort, with an open Fire, increaſed at laſt, ſo as to keep the Retort red-hot for 2 Hours. There came out no more than exactly the ſame Quantity of Quickſilver that had been put in; it was very fluid, and there remained at the Bottom a Maſs of Tin fixed to the Glaſs, with a little of a yellow Subſtance, that was in a Manner foliated. This Maſs was fuſible like Tin, with a moderate Fire; and then the Surface expoſed to the Air was painted of different Colours. The Maſs of Tin weighed ℥j ℥vjſ℈, and there was alſo a little of the yellow Subſtance above-mentioned. It is certain therefore, that with the Help of a Motion continued for ſo long a Time, Quickſilver cannot diſſolve Tin in ſuch a Manner, that Quickſilver may be extracted from it, by a Diſtillation made with the ſtrongeſt Fire.

Scholium. What I have obſerved in theſe 3 laſt Operations, is very ſingular, that the Quickſilver ſeparated from the Lead or Tin by Diſtillation, was extremely liquid, and that being ſtirred in a clean, white, glazed earthen Pot, it ſoon ſtained the Surface of the Pot, and left a very black Spot there, ſticking very hard. As ſoon as I had cleared away this Spot, by wiping it with a very clean dry Paper, there was preſently formed another, and ſo ſeveral Times ſucceſſively. This made me think it was owing to a fat Part of the Metal, which paſſed over in Diſtillation with the Quickſilver, remained fixed to it's Surface, and was then ſeparated from it. To ſatisfy myſelf of this, I ſpread the Quickſilver upon very clean, dry Paper, and it left a ſlender black Mark wherever it had paſſed; and beſides, the Surface of this Quickſilver was always covered with a very thin Skin, which ſeemed like Fat. Therefore, though by Diſtillations of Quickſilver often repeated, ſome Particles of other Metals may be united with the Quickſilver, it will not follow, that any of them are changed into Quickſilver.

* *Nov. Lum. Chem. Tract.* 9.

3. I bought at the public Shop of *Amſterdam* ℥ijſs of the pureſt Gold that could be prepared by the aſſaying Art, and reduced it into ſmall Maſſes, weighing each ℥ſs. I put theſe 5 into a clean Glaſs Retort, and poured upon them ℥xxv of pure Quickſilver, once diſtilled. I then forced half the Quickſilver to riſe from the Gold, which ſubſided at the Bottom under the Quickſilver. The Operation being thus performed, there came over ℥xiij of Quickſilver into the Receiver; the Gold was now at the Bottom of the Veſſel quite diſſolved in the Quickſilver, in Form of a white, perfect Mixture, called Amalgama: Hence it appears, that Gold is diſſolved by the mere Heat of boiling Quickſilver; and this ſeems the beſt Way of mixing them, which in Terms of Art is called amalgamating, The Quickſilver, which had come over, was well dried, and put upon the Reſidue in the Retort; I again expreſſed from it by Fire an equal Quantity of Quickſilver, which being dried, I poured again upon the Reſidue. This I repeated 50 Times. The laſt Time the Quickſilver came off pure. I beat the blackiſh Amalgama remaining at the Bottom of the Retort in a Glaſs Mortar with a Glaſs Peſtle, the Water was turbid, and I poured it off. I waſhed it with fair Water, which again became muddy by beating. I did this 13 Days, when the Water no longer became foul, but the Amalgama became of a ſhining bright Colour, and the Water remained clear. This Powder, prepared by beating and waſhing, of a brown Colour, of an abominable metallic Taſte, weighed Gr. lxxxiii. The Quickſilver and Gold weighed ℥xxvj ℥vij. There were loſt Gr. vii ℥iijſs by the 50 Operations. This happened partly by the Diſperſion of the volatile Quickſilver, partly by the Adheſion of it to the filtring Paper, in which it was dried, and into which it was received in Diſtillation.

Part III. No. 444. *p.* 368. Nov. *and* Dec. 1736.

I treated this very pure Amalgama 50 Times more after the ſame Manner. The Quickſilver now came pure the 50th Time, and there remained a brown Amalgama at the Bottom of the Veſſel. Being beaten and waſhed as above for 13 Days, it yielded ℥j Gr. xliv of waſhed, brown, dried Powder. Then the pureſt Amalgama with the Quickſilver brought off weighed ℥xxvj ℥iv: I loſt by theſe 50 Operations ℥j Gr. xvi.

I again diſtilled this depurated Amalgama 50 Times after the ſame Manner. The Quickſilver came over pure, and there was a reddiſh Amalgama at the Bottom of the Retort. This being beaten and waſhed as before for 14 Days, gave ℥j Gr. ii of a brown Powder. I added the Quickſilver that came over to the pure Amalgama: They weighed together ℥xxiv ℥v Gr. xxiv. But at the Bottom of the Retort, whilſt the Amalgama was poured off, there remained ſome of the Amalgama ſticking to the Glaſs, ſo that I could not compute the Loſs.

I treated the depurated Amalgama again in the ſame Manner 50 Times, diſtilling, beating, and waſhing it 14 Days: It yielded ℥jſs Gr. iv of a brown Powder. The Amalgama was exceedingly bright, and being

being mixed with the pure Quickſilver brought over, weighed ℥xxv ℈ij Gr. xlvi after 200 Diſtillations.

I urged this Amalgama again 50 Times as before, and then beat it with Water for 16 Days. I obtained ℈ij ℈j Gr. iv of a brown Powder. The ſhining white Amalgama with the Quickſilver weighed ℥xxv ℈j Gr. xlvi.

Having gone through this Labour, I perceived, that by 250 Diſtillations of Quickſilver from Gold thus performed, the Gold and Quickſilver afforded ℥j Gr. v of the deſcribed Powder: That there remained of Gold and Quickſilver ℥xxv ℈j Gr. xlvi: That there was loſt ℥j ℈ij Gr. ix.

When I conſidered this attentively, I began with Joy to ſuſpect, that I had found the deſired Method of purifying Quickſilver. I thought ſometimes, that all this Powder was a mere fetid and foul Sulphur, which had ſtained the unſpotted Virginity of Quickſilver. I doubted whether I did not now ſee the Meſſenger of the Gods naked, and pure from the Bath of Fire and Water. This Rapture was a little moderated by the Remembrance of a like, but precipitate Joy, which had often vaniſhed into Smoak. I was determined not to reſt till I was ſatisfied of the real Truth. Therefore I diſtilled ℥xxv ℈j Gr. xlvi of that laſt pureſt Amalgama again 627 Times, drawing off conſtantly half the Quickſilver, and pouring it on again; I would not waſh it any more with Water, but ſee what would become of it. The Matter uſed to grow duſky by this Operation, till at laſt it was almoſt black. I then covered the Glaſs with a Lute, that was able to bear the Fire, and not waſhing the black Amalgama, urged it with a very ſtrong Fire, ſo that the Retort was red-hot full 3 Hours. There came over ℥xx of the pureſt Quickſilver. On breaking the Veſſel, I found at the Bottom ℥ijſſ of the moſt ſhining Gold, without any Droſs. This I thought a ſufficient Recompence for all my Labour.

I then took the Powder, which I had collected from 250 Diſtillations, and urged ℈vij Gr. lvii of it with a very ſtrong open Fire, in a luted Retort, ſo that it was red-hot a long Time. From this Powder there came ℈vij Gr. xlvi of the pureſt Quickſilver. There remained at the Bottom of the Retort Gr. vi of a brown Powder.

I weighed the Quickſilver, which I had now diſtilled 877 Times, by the Art, Induſtry, and hydroſtatical Ballance of my dear Friend the famous *'sGraveſande.* It was to pure Water as 13 ½ to 1: So that the Denſity of the Quickſilver was not altered by all this Labour, nor freed from any lighter Part. I mention this, becauſe I underſtand, that the Method mentioned in my firſt Paper, was not thought accurate enough. Give me Leave now to deduce ſome Truths from what has been ſaid.

1. Gold diſſolved by Quickſilver, and ſo often boiled and pounded with it, changed nothing of it's former Nature, loſt nothing of it's proper Weight, and gained nothing.

2. Quick-

2. Quickſilver mixed with Gold, and ſeparated from it again by Fire, was in Part changed to a brown, ſubtile Powder, of an abominable, metallic Taſte, of a quite different Diſpoſition from it's former Nature, and that conſtantly, even to 877 Times. But yet, by a ſtronger Fire, it returned to Quickſilver again, the ſame in every Reſpect, as far as Art could diſcover.

3. Therefore Fire and Gold do not by theſe Means ſeparate from Quickſilver different Parts, Sulphur, Droſs, or any Thing elſe: But only change it as to it's external Form, reducible however to it's priſtine Appearance, the ſame in every Reſpect, not being altered even in it's ſpecific Gravity.

4. Quickſilver and Gold by the Force of Fire preſently change the Silver, ſhining of their Amalgama, to a brown Colour, and at laſt to a black: But the Silver Colour being reſtored to Quickſilver, and the yellow Colour to Gold, ſhew that this Colour does not demonſtrate the Corruption of the Metals, but the Change in their Nature.

5. But if native Quickſilver can be purged by Gold and Fire, according to the Opinion of the Ancients, it muſt be performed by ſome other Operation.

6. The Hope of fixing Quickſilver with Gold, by the Action of Fire, falls to the Ground: Since no ſuch Thing is ſo much as begun by ſo great a Labour in ſo long a Time, the laſt Diſtillation was as eaſily performed as the firſt.

7. Hence we have no Confirmation of the Opinion, that Fire can increaſe Metals or Quickſilver by concreting with them, or generate any Thing metallic; or form any durable Change of the Metal.

8. How conſtant, how ſimple are Gold and Quickſilver! If Gold was Quickſilver in it's firſt Origin, may we not juſtly ſay, either that the Quickſilver totally flew away by the Fire, or that it remained wholly fixed in it.

9. The great Promiſes of diſſolving Gold by grinding it, either with Water or without, which have been made by two great Men in this Art, are not performed by theſe our Labours. It was a vain Hope: They avoided the difficult Labour, and haſtened precipitately to idle Concluſions.

One Thing remained worthy of Inquiry; whether Quickſilver ſo often diſtilled from Gold by the Force of Fire had laid aſide that Property, by which it is turned by Diſtillation into the Powder called *Præcipitatum per ſe?* Therefore I diſtilled thoſe ℥xx of Quickſilver 877 Times diſtilled from Gold, in a clean Glaſs Retort, by ſo great a Force of Fire, that none of the Quickſilver remained in the Glaſs after each Diſtillation, which I repeated 8 Times. At the Bottom of the Retort I found Gr. xii of a red, glittering, ponderous, mercurial Precipitate, of an abominable, metallic Taſte. I am certain therefore, that even this Property is not taken away from Quickſilver by all this Labour.

XXI. Among

An Examination of the Mexican *filtring Stone, and Compariſon of it with other Stones, by* Abr. Vater, *M. D.* & P. P. Soc. Imper. Nat. Cur. & Reg. Britann. & Boruſſ. Soc. No. 438. *p.* 106. July, *&c.* 1735.

XXI. Among the various Exoticks, brought from both *Indies*, with which our Age greatly abounds, the *Mexican* filtring Stone does not hold the loweſt Place. It is ſo called, becauſe it's porous Texture affords a Paſſage to Liquors, for which Cauſe large Pieces of it are hollowed in Form of Pots or Mortars, which are uſed to ſtrain Liquors for drinking. It is imagined, that Liquors filtred through this Stone, are freed from all their Impurities, become more clear and pure, and conduce more to Health. Hence theſe Stones are highly eſteemed in *Japan*, and are valued equally with Gold, becauſe the *Japoneſe*, who know nothing of the Stone, or other Diſeaſes of the Kidnies, and prefer their Health far before the Goods of Fortune, are of Opinion, that thoſe *Fungi* converted into Stone have a Power of prolonging Life, as may be ſeen more at large in *Valentini*'s Hiſtory of the filtring Stone, in his *Muſeum Muſeorum*, *Lib.* I. *Cap.* 22. This Sort of *Fungus* grows, as is there mentioned, to the Rocks in ſome Parts of the Gulph of *Mexico*, about 100 Yards under Water, and is hardened to Stone by the Air. I will not determine what we are to think of this Origin and Manner of growing of the filtring Stone, though it is very ſuſpicious, and ſeems to have been invented, to make it be thought no vulgar Stone. *Lentilius*, *Ephem. Germ. Cent.* iii, *Obſ.* 176, writes, that theſe Veſſels are of 2 Sorts, ſome being of a dark grey Colour, like Slate, brought from *Canada*, and ſold dear, others of a tophaceous Colour, and coming from *Italy*. *Le Clerc* teſtifies, in his Phyſics, that it is digged up *in agro Leodicenſi*, and is much uſed in *Holland*. It was, no doubt, one of this Sort, of which a little Piece, about the Bigneſs of a Wallnut, was ſent me ſome Years ago by Dr *Rittmeyer*, of *Amſterdam*; with which however I was not able to make any Experiments. But after I had fixed it at the Bottom of a Tin Funnel, I made uſe of it to filtre Water, for the Sake of Curioſity. A little while ago the learned Dr *Ehrart* of *Memmingen* ſent me a choice Collection of Foſſils, among which was a *Tophus* remarkably porous, found about *Memmingen*, which, as he aſſured me, being immerſed in Water, ſucked it up greedily. For as ſoon as the Surface of the Water is touched by it, the Preſſure of the Air makes the Water riſe immediately through it's whole porous Subſtance, as we find by Experience it does in Sugar, Salt, filtring Paper, and Sponge. Immediately I began to ſuſpect, that perhaps this *Tophus* might be uſed inſtead of the *Mexican* Stone to filtre Water. In order to try this, I made a Hollow in a Piece of it, and poured Water therein, which I ſaw paſs very faſt through it's Pores. I then had a Mind to make Trial with other Stones, and accordingly took ſome tophaceous *Tubuli* of *Oſteocolla*, and ſtopping one Extremity, poured in ſome Water, which in like Manner tranſuded very quickly through their porous Subſtance. I recollected, that I had a Sponge by me for ſeveral Years, which, when I lived at the *Caroline* Baths, I had laid in the Canal through which the hot Waters are brought to the Baths, where being incruſted by the Okre, which thoſe Waters carry along with them,

it

it degenerated to a *Tophus*. I hollowed this Sponge, and poured in ſome Water, which quickly ran through it. Having ſeen this, I determined to make Trial of the very *Tophus* of the Baths, of which I had a pretty large Piece, and accordingly gave it to a Maſon, to form it into a Mortar, that I might ſee whether Water would paſs through ſo denſe and ſolid a Stone. My Expectation was anſwered, for the Water ran through in like Manner, but not ſo faſt, becauſe of the Thickneſs of the Stone. I now flattered myſelf, that by this Experiment, I had made ſome Diſcovery, that might ſerve to illuſtrate the Generation of the filtring Stone under Water: For as the *Tophus* of the Baths is gradually generated by thoſe Waters depoſiting their Okre, in running through the Aqueducts, and dropping from them; I thought that the Sea, by ſhaking the Stones, depoſited the ſalino-terreous Parts, from which this *Tophus* is generated by a ſucceſſive Concretion, and grows to the Rocks, rather than ſprouts from them, after the Manner of a ſtony Agarick, or *Fungus*. But becauſe the Origin of this Stone, as we have ſeen already, is very doubtful, and it is not certain, whether it is taken from the Bottom of the Sea, or rather digged out of the Earth, I dare not affirm any Thing concerning it. But conſidering the remarkable Thickneſs of the *Tophus* of the Baths, notwithſtanding which the Water paſſes through it, I had a Mind to try the ſame Experiment with the common Stone that we uſe in building Walls. The Event anſwered the Expectation, for a Mortar made of one of thoſe Stones, ſerves me now inſtead of a *Mexican* filtring Stone, and the Water paſſes equally clear through it. The Water thus filtred, acquired indeed at firſt an earthy Taſte, which ceaſed however by repeated Filtration, as the above-mentioned *Lentilius* obſerved of that filtring Stone. There is no Doubt, but that other Stones may perform the ſame, becauſe even the hardeſt and moſt ſolid Flints, with which the Streets are paved, imbibe the Water, as we obſerve in a wet Seaſon. But this is manifeſt, that the more ſolid and thick the Stones are, and the more narrow their Pores, with ſo much more Difficulty do the Waters paſs through them.

But now to come to the Virtue aſcribed to this filtring Stone, by which the Waters filtred through it are ſaid to be freed from all Dregs and Impurities: For thus we read in the above quoted Hiſtory in *Valentini*'s *Muſeum*, that the Water filtred through it, though ever ſo clear at firſt, always depoſits ſome Quantity of Dregs, and becomes ſenſibly lighter, purer, and much more fit to preſerve Health, nay, that it may be longer kept freſh, and without freezing, or corrupting. If this was true, and Waters could thus be freed from all heterogeneous Parts, the filtring Stones could never be valued enough. For what conduces more to Health, than pure Water taken in Meats and Drinks? But vaſt Tracts of Land are deprived of this Benefit, where the Waters are ſalt, nitrous, vitriolic, and aluminous, and frequently infected by mineral Particles, which may give Riſe to many Diſeaſes. It ſeems very probable, that ſuch Waters depoſite thoſe Impurities in paſſing through

the Filtre, becauſe we ſee, and Experience witneſſes, that Rivulets riſing in ſandy and gravelly Places, and paſſing through Beds of the ſame Earth, are much more clear and pure than other Springs. But thoſe Waters do not owe their Purity to their having depoſited their Impurities in paſſing through the Sand and Gravel, but their not having thence derived any. For we learn by Chemiſtry, that not only Salts, but by their Means other heterogeneous Corpuſcles, earthy, ſulphureous, and mineral, being diſſolved in Water, and cloſely connected therewith, cannot be ſeparated from it by Filtration. We ſee that the moſt ſolid mineral Bodies, Quickſilver, Antimony, Lead, and others, diſſolved in Menſtruums, penetrate through the Pores of the filtring Paper, which afterwards being abſtracted from the Embraces of the Water, and diſturbed from it's Interſtices by Precipitation, are ſeparated, and on being filtred again, remain in the filtring Paper. But ſome perhaps will object, that a thick, denſe filtring Stone can do more than Paper. But the contrary is teſtified by Waters exuding and diſtilling in Mines and ſubterraneous Caverns from the very Rocks, which preſently are petrified, whence the *Stalactites* ariſes. From this alone it is manifeſt, how little the moſt ſolid Stones, and conſequently filtring Stones, conduce to the Depuration of Waters, and to the Separation of ſalino-terreous and mineral *Scoriæ* diſſolved in Water. I will not deny however, that turbid and muddy Waters may be rendered clear by being filtred through thoſe Stones, becauſe thoſe Impurities are not diſſolved in the Waters, and united with them, but only float upon them. But that Waters do not become otherwiſe more pure by this Method, I am ſatisfied by repeated Experiments made with the filtring Stone received from *Holland*, and alſo with the *Tophus* of the *Caroline* Baths, and with the common Stone, by ſtraining the Waters of various Rivers and Springs through them, and examining their Gravity both before and after Filtration by the Hygrometer, but I have hardly found any ſenſible Difference. Thoſe therefore, who do not enjoy the Bleſſing of pure and wholſome Springs, had better uſe Rain-Water, which is freed by Diſtillation from all Impurities, and ſo is the moſt clean and wholſome.

An Account of Coal-Balls made at Liege, *by* William Hanbury, *Eſq; F. R. S.* No. 460. *p.* 672. April, &c. 1741.

XXII. In Purſuance of the Orders of the Society, I ſhall endeavour to give an Account of the factitious Coal made at *Liege*. But firſt I ſhall quote two Authors, who mention it in their Accounts of the Town of *Liege*.

The firſt is, *Le Curieux Antiquaire, ou Recueil geographique & hiſtorique, par le Sieur* P. L. Berkenmeyer *à* Leide 1729, *p.* 182, where he ſays, "This Biſhoprick (*Liege*) has rich Mines *of Houille, or Stone-Coal* *, which the Inhabitants ſell in the *Netherlands*, and by the Sale of it, they get above 100,000 Ducats *per Annum*.

* The common People call their Pit-Coal, *del Hoy*, or *de la Houïlle*; and the Mixture of Coal and Clay, *de Houchy*. *C. M.*

"This

" This Coal lights eaſily, and gives a great Heat: It is not there-
" fore to be wondered, that Fire is reckoned amongſt other Advan-
" tages the *Liegois* boaſt of: They ſay they have the beſt Bread, the
" hardeſt Iron, and the hotteſt Fire: By this laſt they mean, *de la*
" *Houille*, which, being once well lighted, caſts the greateſt Heat, if
" it be wetted with Water."

The ſecond Book I ſhall mention is, *Les Délices des Pais Bas*, Vol. III. *p.* 243, where I find that this Town *Liege* is ſaid to be " the Hell of
" Women, becauſe they are obliged to work more here than in any
" other Country. They draw the Boats, and carry on their Backs,
" like Slaves, *les Hoilles*, and other Things; and theſe Women are called
" *des Botreſſes*."

In the Year 1628, by a printed Paper produced before you, it appears, that this Fuel was known in *England* at that Time; and if you will believe the Author of that Paper, it was diſcovered by *Hugh Plat* in 1594.

There is an Account of it printed in the Eſſays for the Month of *December* 1716, where it is propoſed to be made with the black Ouſe of the *Thames*, and for Four-pence *per* Buſhel *.

I have uſed this Coal and Clay mixed upwards of 10 Years, and by Experience I find it to anſwer very well. It is a moſt excellent Fire for roaſting, for heating of Irons, or warming a Room: I uſe it in my Kitchen, Laundry, Parlour, and Library.

The Method in which it is made at *Liege*, where I firſt ſaw it, and made ſome myſelf, is as follows:

Take $\frac{1}{3}$ of unctuous Clay, (ſuch as Brewers uſe to bung their Veſſels, in it there muſt be neither Sand, Gravel, or Stone)

And $\frac{2}{3}$ of Coal-Duſt: Mix, and make them incorporate well together; caſt them into round Balls, or Bricks, and you may put them on a Coal-Fire, and they will burn directly. But if they are made in Summer-time, and laid to dry for Uſe in Winter, they will light ſooner.

Thus you have an hot, clean, laſting Fire, not at all offenſive to the Smell.

The Duſt is there the Refuſe of the Mine, and may be here of the Coal-Merchant's Yard, ſo that this Fuel comes exceeding cheap.

Nor is it neceſſary to put ſo much Coal-Duſt; for ſome Clay (particularly what I uſe myſelf in the Country) will do, if mixed $\frac{2}{3}$ Clay, $\frac{1}{3}$ Coal-Duſt; and the true Proportion of the Mixture muſt be found by Experience; but it is always better to put in too much than too little Coal-Duſt at firſt, becauſe Men are too apt to be diſcouraged in making Experiments.

* It is mentioned alſo by *Ray*, in his *Obſervations Topographical*, &c. p. 58. *Lond.* 1673, 8vo. *J. M.*

This Fuel is not only to be had at an eaſier Price, but it is likewiſe more durable.

How far it may be uſeful in Glaſs-houſes, Brewhouſes, Salt-Works, *&c.* I muſt leave to the Conſideration of the ſeveral Perſons concerned in them.

I have heard, that at *Liege* they burn both Lime and Brick with it; but, as I never ſaw it done, I cannot affirm it.

Concerning certain chalky tubulous Concretions, called Malm, by Mr Turbevil Needham. No. 471. *p.* 634. *Read* Dec. 22, 1743.

XXIII. This Bed of Malm lies in a Valley, at the Foot of a long Ridge of chalky Downs; extends from *Wincheſter*, where it begins, as I have been informed, almoſt due S, about 4 meaſured Miles; the Breadth not above $\frac{1}{4}$ of a Mile; and Depth, at a mean Computation, about 5 Foot. It is uſed in Manure for the ſame Purpoſes as Chalk is, but anſwers the Intent much better. It riſes up in one continued Bed, almoſt to the Surface, where a thin Layer of common Earth but juſt hides it in all Places, where continual Cultivation has not ſuperinduced a new Soil. Horſetail, and a Species of wild Trefoil, grows out of it very plentifully, eſpecially the firſt, which ſink their fibrous Roots to a conſiderable Depth in it: The whole Bed conſiſts of ſeparate detached Pieces, in the Nature of thoſe which you have by you, and of ſeveral Dimenſions, as thoſe are, moſtly long and tubular; ſome few round, with a ſmall Cavity in the Centre, others quite flat, and ſome, as it were, excavated on one Side, as if the chalky *Laminæ* had extended themſelves round a Piece of Bark; but all of them hollowed within, agreeable to their exterior Shape, except very few. I believe it may be aſſerted, with ſome Confidence, that this Valley formerly was over-run with Wood, if not wholly, at leaſt for ſome conſiderable Length and Breadth: Wild Boars Tuſks, which are known by their Length; Stags Horns, and a Flint Knife, which have been found buried to ſome Depth, in the Malm, ſeem to evince as much. That Trees of conſiderable Dimenſions have grown in it, is very evident; for in a Drain, which they have lately made to convey the Water from the main River to the adjacent Meadows, Trees of a vaſt Size may be ſeen, at 2 or 3 Feet Depth, in no ſmall Number, retaining both Shape and Subſtance in ſome Meaſure, though much decayed, and not ſo compact and ſolid in thoſe Parts, which have been expoſed to the Water; theſe lie out of the Verge of this Bed of Malm, and are not conſequently affected by it. Now I am much inclined to think, that theſe Trees, together with the reſt of the Wood, might, by Age, and ſome Accident combining with it, have fallen; the uppermoſt might have ſerved to bury the reſt, and preſerve them from a more immediate Decay, by cutting off their Communication with the exterior Air. Rains, in Proceſs of Time, muſt have waſhed off from the adjacent Hills to ſome certain Diſtance, and depoſited in the neighbouring Valley, but mixed with other heterogeneous Subſtances, as decayed Wood, Earth, *&c.* a Quantity of chalky Particles, ſufficient to involve, by a continual Addition of new

Laminæ,

Laminæ, Roots, Trunks, Branches, Twigs, and the broken Extremities of Twigs; and tending continually to form Maſſes reſembling the ſuppoſed Particulars. I do not now imagine, though I once thought ſo, that theſe chalky Particles have penetrated the Wood itſelf, and converted it into it's own Subſtance, in the Nature of ordinary Petrification, except here and there ſome few particular Pieces; but I rather ſuppoſe, that the Pieces of Wood have been inveſted continually by additional *Laminæ*; that the firſt *Laminæ* muſt have adapted itſelf to, and aſſumed the exterior Shape, whether ſmooth or knotty, of the incloſed Wood; that the others have proceeded accordingly; that the Extremities have gradually rounded themſelves; and that in the Interim, till they were wholly cloſed, the included Wood has been inſenſibly attenuated by the paſſing Moiſture, and, Particle by Particle, either entirely, or in Part only, waſted away. And, though it may be objected againſt this Suppoſition, that ſome Pieces are entirely ſolid, as one of thoſe two large Pieces is which you have by you, and has the Reſemblance of white Thorn; yet theſe are but rarely found, and may very well be ſuppoſed to have been a Species of Wood of a more ſolid and durable Contexture; which might conſequently withſtand any conſiderable Attenuation by Water, long enough to permit the chalky Particles to penetrate, fix, and convert it into it's own Subſtance; while other Woods, leſs tenacious, inſenſibly waſte, and are carried off by the inſinuating Liquid, together with the chalky Particles, which they not only could not arreſt, but prevented effectually, by a Blending and Interpoſition of their own Parts, from adhering to each other. The Reaſons why I apprehend the Proceſs of the whole to have been in the Manner deſcribed above, and anſwerable to my Suppoſition, are, *firſt*, the cloſe Vicinity, I may almoſt ſay, Contact of the chalky Hills, upon which this Bed of Malm attends throughout the whole Line, and no farther. *Secondly*, That this Malm is an alkalizate Body, in a Degree ſomething inferior to Chalk, as I found upon a Trial, ſome Time ago, by putting equal Portions of each into equal Quantities of double-diſtilled Vinegar, and meaſuring the Height of the Fermentation in a long cylindrical Glaſs. *Thirdly*, The Reaſons, which I gave above, for ſuppoſing that this Valley formerly has been over-run with Wood. *Fourthly*, The Diſpoſal of the ſeveral detached Pieces of Malm, which lie in all Manner of Directions. *Fifthly*, The Reſemblance which they bear to Roots, Trunks, Branches, Twigs, *&c.* *Sixthly*, Some additional Obſervations, which I have made ſince my Return from *London*; and thoſe, I think, are almoſt deciſive. In the Hollow of ſome of the oblong tubular Pieces, which were cloſed at both Ends, upon breaking them open, I found the Remains of the included Wood attenuated to a mere Thread, which, though extremely tender, I could plainly diſcover to be Wood, both by it's exterior Appearance, as well as by rubbing in my Hand, in order to try if it would colour it, as decayed Wood, that has imbibed Moiſture, will do. Within the *Laminæ* of ſeveral, I found a fair Impreſſion of Leaves, in

no

no ſmall Number, and with little Trouble: The Leaves I knew not, as not being very familiar in the vegetable World, though they appeared to me much to reſemble white Thorn-Leaves in their Shape, differing in this alone, that the Impreſſion of the fore Part of the Leaf had many ſmall indented Cavities, equal in Size to a Pin's Point, which had been formed by ſmall Protuberances in the Leaf itſelf. Some Pieces I found quite flat, as if the chalky *Laminæ* had involved a Chip, and the Cavity conſequently went off inſenſibly leſs towards each Extremity. Others I found, whoſe Cavities at the Extremities were irregularly ſhaped, agreeable to the jagged Ends of broken Sticks. Some, in fine, I found excavated on one Side, and convex on the other, as if the *Laminæ* had ſurrounded a Piece of Bark. Theſe are the chief Obſervations which I have hitherto made, and which, I hope, are ſufficient either to fix the Point where I have placed it, or to enable you to draw better Conſequences. I cannot ſay, that I am ſo thoroughly ſatisfied with what I have advanced, as to judge it unqueſtionable; though I am ſenſible, that the finding of ſeveral Maſſes of Malm, the Structure of which is not reducible to, nor explicable by, this Scheme, is no Objection to it; becauſe, as every one knows the Tendency which chalky Particles have to diſpoſe themſelves in *Laminæ*; ſo theſe *Laminæ* may involve Bodies of different Kinds, as Parts of the fibrous Roots of Weeds, ſmall Seeds, or the like; may aſſume their Shapes, increaſe continually in Bulk, and inſenſibly raiſe the Height of the Bed, where they are firſt formed.

Of the Nature of Amber, by John Ambroſe Beurer. No. 468. *p.* 322. *Read* Jan. 27, 1742 3.

XXIV. I abſolutely deny, that Amber is the reſinous Juice of a Tree, for the following Reaſons. Firſt it is not probable, that Amber ſhould paſs through the Earth into the Sea: For whence is that Paſſage? ſeeing the Trees are not very near the Sea.

Then this Reſin can by no Means paſs through the Earth like Water, or diffuſe itſelf ſo copiouſly through it; if this was poſſible, it would rather grow ſtiff, and adhere to the Surface of the Earth.

Beſides, the Heat of the Sun, however great and continual, can never produce ſuch a Flood of Reſins, as to fill ſeveral ſubterraneous Tracts: For the *Exudation* of Reſins is made by Drops, the leaſt Part of which reaches the Ground, the greateſt Part adhering to the Bark of the Tree. Moreover, why is Amber often found on Mountains, and in Pits, where Trees were never planted? Laſtly, the Arguments drawn from the Diſtillation of a vitriolic Acid with Turpentine do not prove what they were intended to prove, becauſe though ſomething bituminous is thence produced, yet it is not real Amber; for it wants the equal Mixture, Tranſparence, Elaſticity, and Hardneſs. This may be more eaſily produced, and almoſt *Extempore*, by the Mixture of any diſtilled ethereal Oil concentred with a vitriolic Acid, from which Mixture there preſently ariſes ſomething bituminous, but not Amber.

To me it ſeems probable, that Amber derives it's Origin, not from a Vegetable but a Mineral, that is, from a tender Bitumen (*Oleum Naphtæ*)

Naphtæ) and an acid vitriolic Sulphur, which mixes itſelf in Form of Steam, and immediately grows hard. This is alſo proved by the foſſil Amber; for whereſoever that is digged up, there are alſo found amongſt the blue Clay, bituminous Wood, Coal, Vitriol, and often Allum. But the Amber, which is found in the Sea, is produced after the ſame Manner as that which is formed in the Mountains, being only waſhed out of the Earth by the beating of the Waves, and partly ſwallowed up by the Deep, and partly thrown up on the Banks.

I ſhall add but one Obſervation more, that as the vitriolic Acid, together with a Bitumen, produces the Form and Appearance of Amber; that Acid will quite diſſolve it again, and leave it in the ſame State, without the Deſtruction of any conſtitutive Part, and reduce it's Hardneſs, Tranſparence, and Elaſticity.

Nuremberg, Oct. 20, 1742.

An Account of petrified Oyſters, by Cornelius le Bruyn, *illuſtrated by* James Theodore Klein, *F. R. S. &* Sec. Rep. Dantzick.

XXV. That indefatigable Traveller *Cornelius le Bruyn*, among other Things worthy of Notice, relating to Natural Hiſtory, mentions Oyſters, of which not only the Valves, but even the Animals themſelves were petrified within the Shells.

At firſt Sight, both his Account and Figures ſeemed ſuſpicious, and delivered with more Confidence than Truth; but let us hear his own Words.

"At ſome Miles from *Nicoſia*, there is a Hill, which conſiſts wholly "of petrified Oyſters.——The Shells are cloſe ſhut, and when they "are opened, there appears an Oyſter on each Side, ſo well conſumed, "that one might ſay it was well engraved there. Theſe Shells are alſo "petrified, or turned to Stone.——I opened one—in the middle of "which there was an Oyſter quite entire, and at the ſame Time, as it "were, engraved in the other Shell *."

No. 459. *p.* 568. Jan. *&c.* 1741.

I did not wonder at the Shells being turned to Stone, but it ſeemed ſtrange, that the animal Oyſter ſhould be petrified; nor did the Author's Reaſon of this *Phænomenon* appear to be ſufficient.

"When we take the Sand out of the firſt Shell, we ſee the Oyſter, "which is in like Manner conſumed by Time, whence we muſt con-"clude, that theſe Oyſters have been alive there, and that the Water "running out, the Sand has inſenſibly ſupplied it's Place, and that the "Oyſter, as it died, left the Print of it's Shape in the Shell.——Thus "there are ſome of theſe Oyſters, like thoſe Stones in which we ſee a "Fiſh."

You will hardly underſtand what is meant by the Shape of the Oyſter, a ſoft and corruptible Animal, being impreſſed on it's Shells, before the Shells themſelves, by Nature hard, were turned into Stone; nor will you eaſily come into the Author's Opinion: That it ſhould be poſſible for an Oyſter to imprint it's Shape on the Shells, in like Manner as the

* *Voyage*, Tom. II. *à Paris & Rouen*, 1725, 4to.

Skeletons

Skeletons of Fiſhes leave their Impreſſion in ſoft Earth, which is afterwards turned to a Stone, for the moſt Part flaky.

Therefore I thought it not amiſs to explain this Account by Schemes of a *Lithoſtreum*, which I got whole out of a very hard Stone of the Mountain *Zijanken-Berg*, near *Dantzick*, in 1736.

But it muſt be mentioned before-hand, 1. That the figured Stones of *Dantzick*, containing many extraordinary vegetable and foſſil Subſtances, eſpecially of the Mountains *Hagels-Berg*, and *Zijanken-Berg*, are formed of Potter's Earth and Clay mixed with a little Sand, grey, and generally very hard; ſo that being beaten with an Iron Hammer, they fly aſunder like the *Vitrum foſſile Imperati*. 2. That they contain Abundance of Shells of *Cochlidæ* or *Conchæ*, very often entire, petrified, but very diſtinguiſhable by their natural Colours; ſometimes, when the *Matrix*, as it is called, is leſs compact or hard, partly calcined, and partly petrified.

Now in the above-mentioned *Lithoſtreum*, if I miſtake not, the ſame *Phænomena* will appear, which *le Bruyn* has endeavoured, however obſcurely, to deſcribe; wherefore I have taken Care to have an exact Draught of this *Lithoſtreum*, the Valves being opened with great Circumſpection.

Fig. 46. *Fig.* 46 repreſents the lower flat Shell, ſticking tenaciouſly in a very hard Stone, of the Kind of the Rock Oyſters; of which ſee *Liſter de Cochl.* Tit. xxvii, *p.* 182, with the Hinge fluted on both Sides, or *a a*, furniſhed with *Ginglymi*. *b*, A manifeſt Footſtep of a ſtrong Tendon, by which the Animal, when alive, opens and ſhuts the Shells. I have ſuſpected *c c* to be the Fins or Beard of the Oyſter, of a light-grey Colour, and of a very ſmooth Subſtance, diſtinguiſhing themſelves from the Colour and Subſtance of the Stone; and this I was the more eaſily induced to believe, becauſe the Fins of teſtaceous Fiſhes are naturally different in Colour and Subſtance from the other ſoft Parts.

Fig. 47. *Fig.* 47 is the upper Valve, or Concavo-convex Shell, more ſo than the upper Valve of the Oyſter, which is commonly brought to our Tables. Here again *a a* are the *Ginglymi*, and *b* the Antagoniſt Tendon.

Fig. 48. *Fig.* 48 repreſents the Body of the Animal found in the Cavity of the Valves, where *a* ſhews the Footſtep of the tendinous Proceſs from Part of the Concavo-convex Shell: *b* the oppoſite Proceſs of the flat Shell.

Thus the Form of the Animal remained entire; but the whole Subſtance of it was changed to a ſmooth, hard Clay. This perhaps is what *le Bruyn* meant, when he ſaid, "In the middle - - - we ſee the Oyſter "entire, and at the ſame Time it looks as if it was engraven in the "oppoſite Shell."

Fig. 49. *Fig.* 49, the reſt of the Bivalve, by which it appears, that the Shell was leſs ponderous than that of a common Oyſter, ſmooth, and not guttered or furrowed.

Now

Now every Body knows, that in the inner Part of moſt Oyſters, eſpecially in the concave Valve, there is a Sort of Ciſtern, containing the Water which is greedily drawn in, cloſed with a thin ſhelly Plate, and from the Hinge generally equalling the whole Bed of the Animal; and I have learned by Experience, that this Ciſtern, when it is diſtinct from the hard Shell, is apt to deceive the Unſkilful: For it has happened more than once, that one or another has pronounced the Cavity covered with a tranſparent Plate in foſſil Oyſters, to be the Figure of the Oyſter rudely inſcribed on either Shell.

Perhaps ſuch a Shell of Mount *Nicoſia* might impoſe upon *le Bruyn*, "That the Oyſter has imprinted it's Shape on the Shell," when he boldly appeals to his Figure, "as may be ſeen in the Figure:" Whereas even his Figure, conſidered attentively, ſhews nothing but the mere Shell, repreſenting only an imaginary Shape of the Oyſter. I could prove this Aſſertion by many Schemes, but one ſhall ſuffice.

Fig. 50 repreſents a foreign Oyſter with many *Ginglymi*, of *Zijanken-Berg*. Now could any one take upon him to perſuade us, that the Figure circumſcribed by the Letters *a*, *b*, *c*, *d*, *e*, is the Form which the dying Animal impreſſed on it's Shell? When it appears to the Eye, that it denotes the above-mentioned Ciſtern, with only a ſmall Part of the above-mentioned thin, teſtaceous Plate remaining, over-againſt the Letter *b*. Fig. 50.

XXVI. The *Indian-Sand*, which is brought to *Holland*, is ſaid to be chiefly gathered upon the Sea-ſhore in *Perſia*; then it is boiled in Water, to free it from it's Saltneſs, and it is after this a black Powder, conſiſting of Grains of different Bigneſs; ſome of which have a very rough Surface, and others have one Part of their Surface ſomething rough, and the other very ſhining: Their Figure is very irregular, like Grains of common *Sand*, only this *Indian-Sand* is ſmaller. Theſe little Lumps have neither Taſte nor Smell, and are friable, ſo as to be eaſily reduced to a very ſubtile Powder. It has ſome Parts which are ſtrongly attracted by the Loadſtone; and others ſo very inactive, as ſcarcely to ſeem to be magnetical: The ſtrongeſt are the blackeſt; but the inactive ones are more ſhining, and more inclining to the Colour of Lead; theſe are in the greateſt Quantity, and from them the others are got out by a Loadſtone. Dr *Moulen* has examined ſeveral Ways ſuch a Kind of *Sand* which is brought from *Virginia*, and deſcribed it in the *Philoſ. Tranſ.** I have examined the *Indian-Sand* another Way, of which I have given an Account in my *Phyſical Diſſertations*, p. 127; but a great deal ſtill remained to be conſidered, and as there is a great deal more of this Subſtance of the lazy or inactive, than of the active or magnetic Sort, it was proper to try whether a magnetic Virtue might not be excited or increaſed in all of it; and after a few Trials I found the Thing to ſucceed. I ſuſpected that there might perhaps be too

Experiments made on the Magnetick Sand, by Petrus Van Muſchenbroek, *M. D. F. R. S. Prof. Math. and Aſtron.* Utrecht; No. 432. *p.* 297. Apr. *&c.* 1734.

* See Vol. II. Chap. 3. §. xcvi.

great a Quantity of Sulphur adhering to the *Sand*, to ſuffer it to be turned into any metalline Regulus by a long Continuance in the Fire; therefore I toaſted it in an open Crucible for two Hours with half the Quantity of Pot-aſh; afterwards I waſhed away the Salt with Water, and the *Sand* remained much blacker than before, of which I found more than a Quarter endued with a greater magnetick Force. I do not ſcruple to attribute this Virtue to the Salt; becauſe, though the Action of the Fire alone does increaſe the Force of the *Sand*, yet it does not give it near ſo much attractive Force.

Becauſe common black Soap is made of Oil boiled with a Lixivium of Pot-aſh, I had a Mind to try whether Soap might not do more than Salt alone in raiſing the Virtue in the *Sand*; ſo I mixed the *Sand* with an equal Quantity of Soap, which I firſt expoſed to a gentle Fire in an open Crucible, to dry up the Soap which ſwells very much; then the Fire was increaſed for $\frac{3}{4}$ of an Hour, all the oily Subſtance wholly conſumed, and the Matter in the Crucible was ſtrongly fired; then afterwards boiling it in Water, and waſhing it well, I obtained a black *Sand*, which was all endued with a lively attracting Force. Very well pleaſed with this Succeſs, I had a Mind to try whether I might raiſe a greater Force in it; wherefore I again roaſted it with black Soap as before, and even a third Time; but no Addition was thereby made to it's Virtue: I find that ſtaying too long in the Fire is as prejudicial as ſtaying too ſhort a Time; between $\frac{1}{2}$ an Hour and an Hour ſeemed to me the moſt proper Space of Time.

After, I added to the black Soap $\frac{1}{2}$ of Salt of *Tartar*, and mixed thereto an equal Quantity of *Sand*; which, when it had been expoſed to a reverberatory Fire $\frac{1}{4}$ an Hour in a Crucible, I waſhed in Water; and then ſo great was the Virtue of the *Sand*, that if it did not exceed the former, at leaſt it was equal to it.

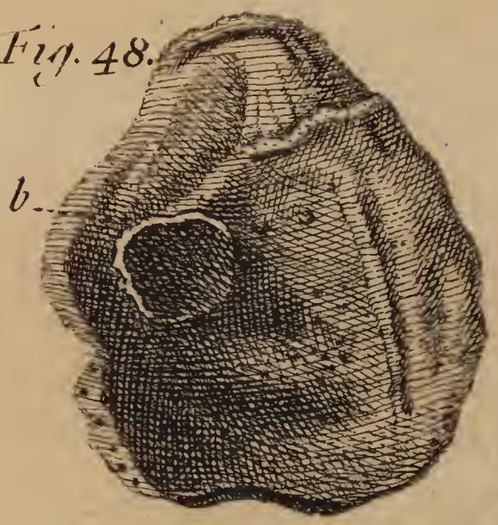
Becauſe I had obſerved the Oilineſs of the Soap to conduce much to excite the Virtue in the *Sand*, I mixed Beef-Tallow with an equal Quantity of *Sand*, and having very well cloſed the Crucible, I expoſed the whole Maſs to a reverberatory Fire for 2 Hours, whereby the *Sand* became much blacker, and received a great deal of attractive Virtue: But that *Sand* became much more active which was burned 2 Hours with an equal Quantity of Pitch, as likewiſe very black, ſubtile, and very little ſhining: But when it was expoſed a longer Time in the ſame Crucible, I obſerved it to be weaker; as alſo, when it was in the Crucible with the Pitch but $\frac{1}{8}$ an Hour, it ſcarce acquired any Virtue; ſo that there muſt be a determined Action of Fire to raiſe the Virtue in the *Sand*. Yet I could not raiſe a greater Virtue in the *Sand* than by the Means following, *viz.* mixing the *Sand* in the Crucible with equal Parts of Roſin, Pitch, Frankincenſe, and Rape Oil, and expoſing it to a reverberatory Fire for an Hour, having firſt well cloſed up the Crucible. Between the black Coals of the oily Matter, there ſticks a very black *Sand*, which leaps up ſwiftly to the Loadſtone, as ſoon as it

is

Fig. 46.

Fig. 50.

Fig. 48.



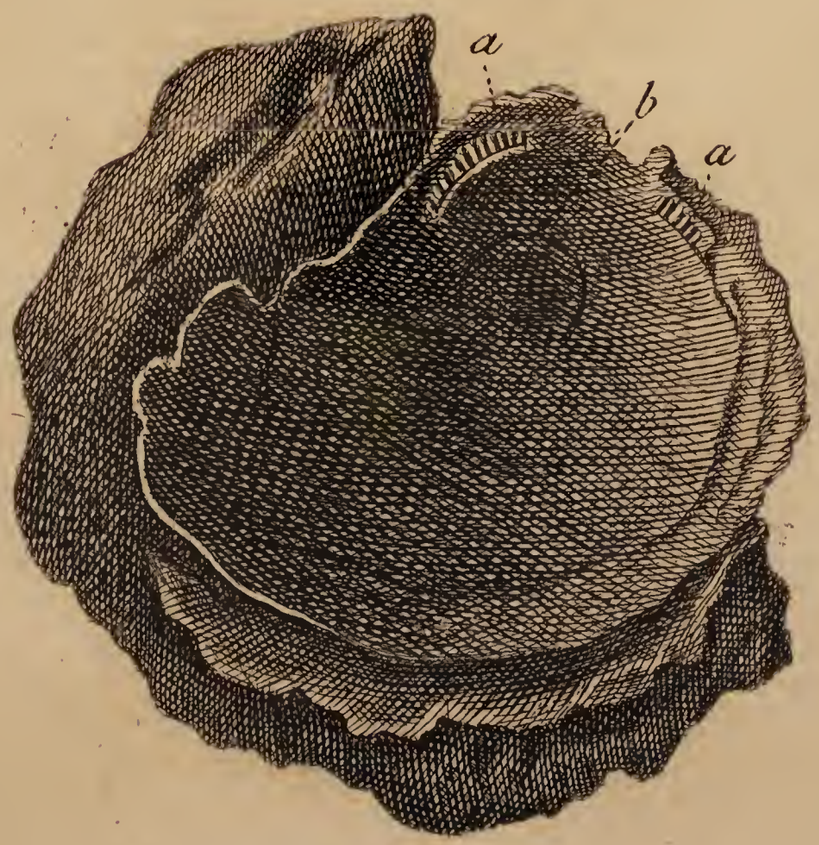
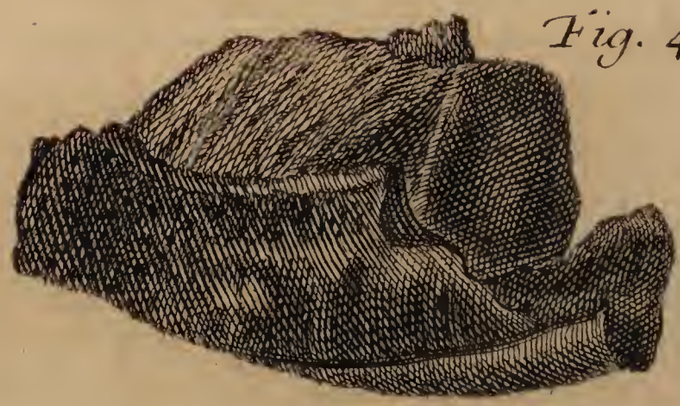


Fig. 47.

Fig. 49.



is brought near it. Then I conſidered whether the *Sand* did not acquire the greateſt Force as it came nearer to the Nature of Steel, by burning it with the Bodies above-mentioned; and ſuſpecting this, in order to try it, I put it among ſuch Bodies as turn Iron into Steel, according to the Operations deſcribed by that great Experimenter Monſ. *Reaumer*, in that excellent Book, entituled, *The Art of turning Iron into Steel.* I took therefore three Parts of *Sand*, two Parts of Chimney-Soot; and of Sea-Salt, powdered Charcoal, and Aſhes, one Part each. Having accurately mixed all theſe Bodies together, they were expoſed for ſix Hours in a cloſe Crucible to a ſtrong Fire; and then the whole Maſs was boiled and waſhed in Water, then dried, and ſo received a great deal of attracting Force; but it was not near ſo active as that which was prepared with Soap, or in the Manner laſt deſcribed.

And now, what can this *Sand* be? Is it an imperfect Magnet, or ſubtile Powder of it, which when it is grown up into a greater Lump, makes the vulgar Loadſtones? So I conjectured at firſt; but when I found by Experience that common Loadſtones expoſed to the Fire, according to ſome of the Methods above-mentioned, did rather loſe of their Force than gain, I altered my Opinion; and now confeſs that I have not yet penetrated into the Knowledge of the Nature of this Matter.

Whatever it be, it is certain that there are ſeveral Kinds of this *Sand*, brought from different Countries of the Earth: For it is brought from *Perſia*; ſome is brought from *Virginia*; there is another Sort in *Italy*, which is common enough at *Leghorn*, and this laſt is naturally very attractive: There are two Sorts found in the *Eber*, a River of *Haſſia*; of which one is like the *Italian*, and the other conſiſts of large Grains, almoſt as big as Hemp-Seed, but ſcarce having any Virtue. I have beſides a very ſtrong Sort, which I am told was got near old *Old Raguſa* in *Dalmatia*. No-body knows how many Kinds of this *Sand* there are: That Time, and the diligent Obſervations of Philoſophers muſt hereafter ſhew.

Utrecht, Jan. 15, 1733, *O. S.*

CHAP. IV.

MAGNETICKS.

An Extract from the Journal-Books of the Royal Society, *concerning Magnets having more Poles than two; by* John Eames, *F. R. S. with some Observations by Dr* Desaguliers *on the same Subject.* No. 450. *p.* 383. Oct. *&c.* 1738.

I. THE sagacious Dr *Halley*, in his Account of the Changes of the Variation of the magnetical Needle, upon the Hypothesis of the Earth's being one great Magnet having 4 magnetical Poles, tells us, that he had found two Difficulties not easy to surmount; the one was, that no Magnet he had ever seen or heard of, had more than 2 opposite Poles, whereas the Earth had visibly 4, if not more, *&c.* I find in looking over the Copy of the Journal-Book of this Society, Vol. II. an Article in the following Words:

July 20, 1664.

" Mr *Ball* produced several Loadstones, and among them two Ter-
" rella's, whereof one seemed to have four Poles, with a Circle passing
" between them, of no Virtue at all. Some of the Company sug-
" gested, that it was probable this Stone consisted of two Stones, by
" Nature cemented together by a Piece that had no magnetical Quality
" in it."

Query, Whether this Stone can be come at, to examine whether it be a single or double Stone? If single, whether the respective Poles were opposite?

An Account of some magnetical Experiments by J. T. Desagu-liers.

In the Year 1715, trying some Experiments upon a very large weak Loadstone, I found that it had several Poles: Then I tried several other Loadstones, and often found 4 Poles in such as had been armed when I took off their Armour. In large coarse Stones I found sometimes 8, 9, or 10 Poles. This made me believe all Loadstones to have several Poles; but when I tried my Lord *Paisley*'s (since Earl of *Abercorn*) Loadstones, and other very good ones, I then found that homogeneous Loadstones had but 2 Poles; those that have more being only an Aggregate of magnetical and other Matter, which makes an heterogeneous Substance. Such is the Society's great Loadstone, for it has several Poles.

An Account of some magnetical Experiments made before the R. S. June 24, 1736, *by the Rev.* J. T. Desaguliers, *LL. D. F. R. S.* Ibid. *p.* 385.

II. 1. I took a Bar of Iron, of $\frac{1}{4}$ of an Inch Diameter (which having been 15 Years in an erect Position, had acquired a fixed Pole at Top, so that the End which had stood uppermost attracted the N. End of a Compass-Needle, and the other End the S. End of the Needle); and having suspended it by a String for the Space of $\frac{1}{2}$ a Year, it acquired a fixed S. Pole at that End, as well as it had done at the other in the Time of 15 Years, without diminishing the Virtue of the other End: So that both Ends of the Rod in any Situation attracted the N. End of the Needle of the Compass.

That Rods of Iron untouched, or which have not acquired a magnetick Virtue by their Situation, will with their upper End (whatever End of the Bar be held upwards) attract the N. End of the Needle, and the lower End

End of the Bar the S. End of the Needle, is a Truth known many Years ago, and mentioned in Dr *Brown*'s Book of vulgar Errors.

An Account of some magnetical Experiments made before the R.S. April 21, 1737, *by the same.* Ibid. *p.* 386.

2. It is well known, and has been often found by Experience, that an Iron Bar untouched by a Loadſtone, will, with it's upper End, attract the N. End of the Needle of a Compaſs, when the ſaid Bar is held upright, and the S. End of the Needle with it's lower End, when applied to it, ſtill in a perpendicular Poſition, whatſoever End of the Bar be held up; unleſs the Bar has acquired a fixed Pole by having been long in a vertical Poſition. But if the Bar from a vertical be brought to an horizontal Poſition, the Needle will return into the Situation it had before, which was in the magnetical Meridian, the Bar being then at right Angles to it. Upon raiſing or ſinking the End of the Bar which is fartheſt from the Needle, the one or the other End of the Needle will begin to move towards the Bar. Such a Bar has in itſelf no fixed magnetick Virtue; but if it had, it muſt be heated red-hot, and then cooled in an horizontal Poſition. A Bar thus prepared is fit to make the following Experiments, communicated to me by M. *du Fay*.

Hold the Bar upright, and give it a Blow or two againſt the Ground with it's lower End; and that End will attract the S. End of the Needle, when the Bar is held horizontal, and at right Angles to the magnetick Meridian: The other End held horizontal in the ſame Manner, will attract the N. End of the Needle. Invert the Bar, and the Virtue of it will be loſt by ſtriking as many Blows with it againſt the Ground with the other End: Then ſtrike another Blow or two, and the End which attracted the N. End of the Needle, will now attract the S. End, and ſo *vice verſa*, the Poſition being ſtill horizontal.

If the Blow be given againſt the Ceiling, or any horizontal Body, with the upper End of the Bar, the ſame Virtue will be communicated as before.

This will likewiſe happen, if the upper or lower End of the Bar be ſtruck with an Hammer or Mallet; whether the Blow be given endwiſe, or at right Angles to the Bar: Nay, though it ſhould be given in the middle of the Bar; the Poſition of the Bar at receiving the Blow being all that is requiſite; for if you give the Bar only a Jerk or Shake in that vertical Poſition, it will receive the Virtue, as if there were in the Iron ſeveral Threads or Beards fixed at one End, as M. *du Fay* ſuppoſes, which the Blow or Shake laid all one Way, and which were placed the other Way by inverting the Bar, and then giving it a Shake or Blow.

N. B. When the Bar is placed horizontally, a Blow in the middle deſtroys it Virtue.

An Obſervation of the magnetic Needle being ſo affected by great Cold, that it would not

III. I formerly made Mention of a ſtrange *Phænomenon* relating to the Sea-Compaſs, which I had frequently obſerved, when we were among the Ice in *Hudſon's-Bay*; to wit, that the magnetick Virtue of the Needle was ſo far loſt or deſtroyed, that it would not traverſe as uſual, even

traverſe; by Capt. Chriſtopher Middleton, *F. R. S.* No. 449. *p.* 310. Aug. *&c.* 1738.

even when the Ship was in a conſiderable Motion: And in my Voyage thither laſt Year, I obſerved our Compaſs would not move at all, any longer than the Quarter Maſter kept touching it. We had then much Snow on the Land, and many Iſles of Ice around us, and the Sea not very ſmooth: I ordered one of the Compaſſes to be brought into the Cabin, but did not find it any better, till it had ſtood near the Fire about ¼ of an Hour, and then it began to traverſe very well; I then ordered it to be placed in the Binnacle, and another to be brought into the Cabin, changing them alternately thus every half Hour, and found by this Means I could make them traverſe as well as in any other Part of the World: I was obliged to continue this Practice, till we got near 100 Leagues from the Coaſt; but afterwards I had no Occaſion for that Trouble. What ſhould be the Cauſe of this wonderful *Phænomenon*, I am not able to conjecture, being certain the Compaſſes, as to their mechanical Structure, were very perfect, and anſwered very well both before and after, during the whole Voyage; there is never any Oil uſed to make them move eaſily, for in that Caſe it might often congeal, and ſtop the Motion of the Card: But whether the Cold of the Climate hath a Power to deprive the Needle of it's Virtue for a Time, or that the Friction is increaſed thereby to ſuch a Degree, as it cannot be overcome by the Magnetiſm, I am not able to ſay; but the Fact is certain and ſurprizing.

April 20, 1738.

Magnetical Obſervations made in May, June, *and* July, 1732, *in the* Atlantic *or* Weſtern Ocean; *by Mr* Joſeph Harris. No. 428. *p.* 75. April, *&c.* 1733.

IV. I ſome time ſince took Notice of the Imperfections of the common Azimuth Compaſs, and how ill adapted that Inſtrument is for the Purpoſe intended. I alſo gave the Deſcription of a new Inſtrument, whereby I propoſed to remedy the principal Objections to the former; and farther Experience has ſufficiently confirmed me in what I have ſaid. But I ſhould be glad to have it determined by thoſe who have convenient Opportunities of making Experiments of this Kind, what would be the propereſt Diameter and Weight for a Needle and Card, and what ought to be their proportional Weights to each other when taken ſeparately: Regard being had that the Friction be no more than what is neceſſary to prevent the Card from being too much affected by the Motion of the Ship. Some Obſervations incline me to think, that a Sea-Card ſhould not exceed 6 Inches Diameter, and that moſt of thoſe generally uſed, are too heavy for nice Experiments, though they may be well enough adapted for common Purpoſes.

In *March* and *April*, 1732, the Variation at *Black-River* in *Jamaica* was very accurately obſerved to be from 6° to 6° 5′ Eaſterly.

Off the *Havanna* about 4 ½ Deg. Eaſterly.

The

The reſt of the Obſervations I made, are expreſſed in the following Table.

Latitude. N.		Longitude from *London*, W.		Variation.	Latitude.		Longitude from *London*, W.		Variation.
Deg.	Min.	Deg.	Min.	Deg.	Deg.	Min.	Deg.	Min.	Deg.
27	00	80	00	4 E.	35	55	65	30	5 W.
28	45	80	00	3 ½	38	06	60	30	6 ½
31	00	77	45	1 ¾	39	10	57	30	8 ⅓
32	15	72	30	00	39	40	56	30	8 ¾
32	40	72	00	1 W.	43	00	45	00	9 ½
32	45	71	30	1 ½	43	05	44	35	9 ½
32	52	70	40	2 ¼	44	40	35	15	11 ½
34	30	67	25	4 ⅓	47	20	20	20	11

The Inſtrument I uſed was ſo eaſily managed, that unleſs the Sea was pretty rough, an Obſervation might be depended upon to about a Quarter of a Degree, had the Card performed to the ſame Exactneſs. But by comparing ſeveral Obſervations made under the like Circumſtances, as to the Weather, it ſeems to me as if the Virtue of the Needle was not always of equal Strength. Sometimes ſeveral Obſervations would agree exceedingly well; at other Times the Card would ſtand indifferently any-where within a Degree or more of it's Meridian; and this I obſerved in ſeveral Cards. I found another Circumſtance which ſurprized me much: The Card would ſometimes differ about 2° from itſelf betwixt the Morning and Evening of the ſame Day; and this Difference would continue as it were regularly for ſeveral Days, then vaniſh for a Week or more, and afterwards would return and continue as before.

The Greatneſs of this Difference, and the near Agreement betwixt the Obſervations made in the ſame Forenoon, or Afternoon, amongſt themſelves, will not give me Room to ſuſpect that it proceeded altogether from an Error in obſerving. I own I cannot account for it, but whatever be the Cauſe thereof, the Error was always the ſame Way; that is, the Weſterly Variation in the Morning would be leſs than in the Afternoon. I carefully examined if this could be any Ways owing to the Inſtrument, or to any Iron near the Place where it was uſually ſet for Obſervation; but I was fully convinced it could proceed from neither. I know not whether any ſuch Obſervations as theſe have been made before; but I think it would not be unuſeful, if thoſe who have proper Inſtruments, and are ſufficiently ſkilled, would communicate any Thing of this Kind that may occur.

It now appears that the Numbers in the foregoing Table cannot be ſtrictly accurate; but I think the Error can ſcarce any-where exceed

half

half a Degree; for in moſt Caſes ſeveral Obſervations were made pretty near together, of which I took a Medium, making Allowances according to the Circumſtances attending each: And perhaps they are as exact as can be well expected from Sea-Journals. And there can be no ſenſible Error as to Longitudes, our Reckoning, when we made the Land, happening to fall out to a more than uſual Exactneſs.

The Variation of the Magnetick Needle, as obſerved in three Voyages from London *to* Maryland, *by* Walter Hoxton. No. 454. *p.* 171. July, *&c.* 1739.

V. *N. B.* The Longitude is reckoned from the *Lizard*.

The firſt Voyage, 1732.

Latitude. North. °	′	Longitude. Weſt. °	′	Variation. Weſt. °	′	
39	53	27	16	12		In Sight of the Iſland *Corvo*. Difference of Longitude from it 35′ W.
37	49	27	45	14		
35	19	39	20	13		
32	40	50	27	8		
34	40	56		6	30	
35	4	65		4	28	
36	50			4	42	Diſtance from Cape *Henry* 7 Leagues.
				4	58	In the Bay of *Cheſepeak*, 3 Miles below the Mouth of *Potomack River*.
				4	47	Off the Mouth of *Potuxon River*.

Return.

Latitude. North. °	′	Longitude. Weſt. °	′	Variation. Weſt. °	′
36	11	56	20	9	22
34	52	53		6	17
34	33	52		6	15
34	45	51		6	5
34	36	50		6	23
36		49	30	7	37
37	20	48		9	23
38	4	48	20	10	
39	27	47	40	10	23
40	8	45	40	10	38

Latitude. North.		Longitude. West.		Variation. West.	
°	′	°	′	°	′
40	30	45		13	4
42	32	42	20	11	43
42	40	42		12	39
43	27	40	20	13	24
43	32	39	50	13	42
49	48	9		16	30

The second Voyage, 1733.

Latitude. North.		Longitude. West.		Sun's Altitude.	Variation. West.	
°	′	°	′		°	′
48	12	3	18	31	18	
46	7	4	30	25	16	35
44	4	7		22	16	22
42	17	9		33	16	36
40		12		37	15	38
38	5	14	20	41	14	51
37	36	14	45	25	13	24
36	32	15	52	47	13	17
36	16	16	12	19	13	
34	2	21	51	35	11	34
34	4	23	18	27	9	51
35	6	30	33	21	10	28
35	12	31	38	20	9	48
34	23	31	22	32	10	23
33	34	32	25	20	8	18
30	19	31	26	23	7	12
29	17	31	11	24	6	45
32	24	37	55	25	6	39
32	50	38	35	25	10	36
32	11	40	23	30	11	
31	19	41	9	25	6	42
32	25	43		26	5	
34	5	47	20	25	8	49
33	45	49	24	31	10	45
35	1	54	10	30	8	33
34		54	4	41	5	54
33	41	54		22	5	12
33	51	55		23	6	35
34	59	60		36	7	2
36	32	59	30	23	7	49
37	1	61	10	33	6	45

Latitude. North.		Longitude. West.		Sun's Alti-	Variation. West.		
o	/	o	/	tude.	o	/	
37	5	66	22	44	5	25	
36	53	66	40	30	4	45	
36	36			30	5		In the *Soundings*, 20 Leagues off Cape *Henry*.

Return.

Latitude. North.		Longitude. West.		Sun's Alti-	Variation. West.	
o	/	o	/	tude.	o	/
38	9	57	40	24	11	
38	48	55	50	25	10	
42	13	43	48	29	14	
44	21	33	17	19	14	26
45	46	28	17	23	15	45
49	51	Off *Plymouth.*			13	27
50	20	Off *Portland.*			13	

The third Voyage, 1734.

Latitude. North.		Longitude. West.		Sun's Alti-	Variation. West.	
o	/	o	/	tude.	o	/
39	53	6	37	28	14	30
37	50	6	40	21	14	
36	58	10	30	26	15	
34	56	13		30	13	40
33	33	16	10	27	12	10
33	9	17	38	27	9	13
32	44	18	6	24	9	51
31	39	20	13	34	9	49
30	55	22	53	25	9	6
30	17	25	26	36	8	39
30	1	27	14	28	7	56
30	1	27	54	27	6	48
29	55	30	20	24	7	41
29	57	33	12	32	8	
29	51	37	37	32	5	41
28	55	39	28	27	5	23
29	8	40		26	7	12
31	10	44	46	30	8	6
31	7	46	45	22	4	46
30	42	49		38	4	40

Latitude. North.		Longitude. West.		Sun's Altitude.	Variation. West.	
°	′	°	′		°	′
30	29	49	48	22	4	
30	31	52	10	25	4	49
30	18	53		25	4	45
30	23	55		25	4	22
30	58	57	30	22	4	52
37	9	68		38	4	50

CHAP. V.

BOTANY.

I. THIS learned and ingenious Performance, in two Volumes in Folio, contains a Dedication to the Prince of *Wales*, a Preface, and 794 Pages.

In the Preface, the Author first lays down a Geographical Account of *Switzerland*, being situated from 46 to 48° in Lat. and 4° in Long. then mentions it's various and almost surprizing Degrees of Heat and Cold within the Space of a few Miles, arising from the different Arrangement of the Mountains: That it is in some Parts destitute both of Corn and Wood from the Intenseness of the Cold; in others, where there are high Mountains to the N, and Openings to the S, the reflected Heat becomes so troublesome, that the Inhabitants are forced to desert the Towns, and take Shelter in the Woods; that in other Parts the Country is so extremely pleasant, that *Tavernier* himself, though he had travelled over great Part of the Globe, declared he never had observed any more beautiful. The Author then mentions, that the Plants produced in such Difference of Soils and Situations, must be very numerous; he accordingly met with not only many of the Plants of the warmer Parts of *France*, almost all the *German* ones, but even those of *Lapland* and *Spitzberg*. These Varieties have been collected in a short Time. You gather in the same Day, the *Bistorts* and *Saxifrages* which *Martens* collected in *Spitzberg*; the yellow *Milfoil*, *Xeranthemum*, *Ephedra*, and other Ornaments of the Southern Part of *France*. The Progression between both Extremes is so regular, that in going from *Bern* to *Grimsul*, you pass first by *Chesnut-Trees*, and other Inhabitants of the warm Countries, then *Vines*, then *Walnut-Trees*, then *Beeches* and *Oaks*, then *Firs*, then *Larch-Trees*, then *Pines*, then barren Heaths producing *Whortle-Berries* and such like, then Rocks, and Plants a Span high, and last of all, beyond which Vegetation ceases, you meet with a Species of round-leaved *Willow*, not exceeding an Inch in Height,

An Account of a Treatise, (intituled, D. Alberti Halleri *Archiatri Regii & Elect. Medicin. Anatomiæ, Botan. Prælect. &c. Enumeratio Methodica* Stirpium Helvetiæ *indigenarum. Qua omnium brevis Descriptio & Synonymia, Compendium Virium Medicarum, dubiarum Declaratio, novarum & rariorum uberior Historia & Icones continentur.* Gottingiæ, 1742, *in Folio) extracted and translated from the* Latin *by* William Watson, *F. R. S.* No. 468. *p.* 369. *Read* Feb. 3, 1742-3.

and the *hairy Crow-Foot* of *Platerus*; beyond this Diſtrict, the Tops of the Mountains are covered with Snow. This great Variety is not (as it muſt be in any other Part of the World) the Collection of many Provinces, but furniſhed within the Space of 17 Leagues; and would be ſtill leſs, if in going from *Sedunum*, you aſcend Mount *Sanetch*, whoſe Top is but 7 Leagues from *Sedunum* [or *Syon*].

The Author adds, that the Sides of the Mountains produce great Variety of Moſſes and Fungus's, that the Paſtures furniſh an inexpreſſible Collection of Graſſes, of which in this Book he mentions 220 Species. The following Kinds of Plants ſeem to be wanting in *Switzerland*, *viz.* the hotter Kind, ſuch as *Thyme*, *Lavender*, and *Roſemary*; thoſe very frequent in champain Countries; thoſe which are produced in Bogs and putrid Soil; ſome of thoſe peculiar to the North, and maritime Plants.

The *Alps* contain about 500 Species peculiar to themſelves, all diverſe, perennial moſt of them, biting, ſcented, and frequently with a white Flower; beſides many Plants common to other Places.

The Author then proceeds to enumerate all the Botaniſts, who by their Journals and Publications have laboured to oblige the World with Hiſtories and Deſcriptions of the almoſt inexhauſtible Number of Plants, which the various Soil and Situation of this Country produces; and after having mentioned the Performances of theſe great Men, he gives ſome Account of his own Travels, and the Progreſs of his Botanical Studies; that he had gone through *Germany*, *Holland*, *France*, and *England*, and made very few Obſervations of the Botanick Kind, at leaſt had preſerved no Specimens of what he had ſeen; but upon his Arrival at *Baſil* to attend the Lectures of *Bernoulli*, and ſtudy Mathematicks there, he was ſeized, as it were, by the Genius of the Place, where thoſe great Writers the *Bauhins* had lived, and were publick Profeſſors; and whoſe Chair at that Time was very worthily filled by *Starhelinus*: That he began to collect, deſcribe, and compile, with ſo great Hopes of Succeſs, however remote, that he even attempted the Work before us, at a Time when he was ſcarcely acquainted with the more common Plants. A Work of this Kind had been begun by *John Geſner* of *Zurich*, a Deſcendant of the famous *Conrad Geſner*'s, and a Friend of our Author's, for which Taſk he was very well qualified by his many laborious Reſearches; but at length his bad State of Health would not permit him to proceed in a Science, where he muſt not be confined only to his Cloſet, but climb up almoſt inacceſſible Mountains, ſometimes nearly periſhing with Cold, and, poſſibly, in the ſame Day, almoſt ſtifled with Heat. This Gentleman not only ſent our Author a great many Plants, but granted him whatever he had occaſion for of his Collection, which conſiſted of a great Number of valuable Specimens, of which he alone was poſſeſſed.

Our Author ſpecifies likewiſe, what Parts of the *Alps* have been looked over, and what remain hitherto unattempted; and then ſhews how

how large a Field is yet behind, for future Botaniſts to exerciſe their Genius upon; and that theſe Mountains have rather been curſorily paſſed over by Perſons travelling over them to remote Places, often at an improper Seaſon, than carefully examined; from whence it happens, that many not only of Moſſes, but of the moſt perfect Plants, have either been omitted, or ſo negligently deſcribed, that it is impoſſible to reduce them to the Genus to which they belong. Add to this, that the *Fungus's*, and the very ſmall Plants, ſuch as the *Centunculus*, *Sedum tetrapetalon*, *&c.* were overlooked by the ancient Botaniſts, and ſeem to have been reſerved for the Induſtry and Perſpicuity of the *Vaillant's*, *Dillenius's*, and *Micheli's*, of the preſent Age. Our Author then candidly confeſſes, that although he had herborized upon many different Parts of this Country for 9 Years, he could by no Means promiſe a full and perfect Enumeration of it's Plants; for the Deſcriptions of the more ancient Writers, eſpecially the Graſſes mentioned by *Caſpar Bauhin*, are ſo obſcure, that it is ſcarcely poſſible to know many of them by thoſe Means; that ſome Plants are inſerted by Authors, which have occurred to no-body ſince their Time; that others, if not quite loſt, he never could meet with, notwithſtanding he travelled for that Purpoſe to the Places where they have been ſaid to be found; which may in ſome Meaſure be owing to our Author's being ſhort-ſighted, from which Defect (he believes) he may, no doubt, have paſſed over ſome Plants, which he had been particularly in Queſt of: That he had received ſome Specimens ſo ill preſerved, as not to be able to diſcover their generical Marks; and, laſtly, that it is almoſt impoſſible to ſave any Seeds of the Plants of the *Alps*, or ſee them in that State, on account of the Snows falling ſo early as the latter End of *Auguſt*, and Beginning of *September*, whereby the Mountains are covered, and rendered unpaſſable.

Surrounded with Difficulties, he deſpairs of perfecting his Catalogue, but hopes he ſhall have the Reader's Pardon, after he is appriſed of the Means our Author took againſt them. Firſt, he carefully marked out the Characters of all his Plants, the Day he collected them; for not being prejudiced in favour of any artificial Method, he looked over the Compoſition of the Flower with regard to it's Petals, *Calyx*, and Seed-Veſſel, after the Manner of Profeſſor *Boerhaave*, at a Time when nobody had conſidered the *Stamina* and *Tubes* as generical Notes: That he compared with his Plants the Botanical Writers of more than 2 Centuries, whoſe Names are mentioned at the End of the Preface, beginning in order of Time with *Brunfelſius*, and concluding with the late Work of Monſieur *Geoffroy*: That he had examined their Deſcriptions of Plants, and compared them with their Figures, and made himſelf a Pinax of the Plants of *Switzerland*, even to the preſent Time.

Our Author, in the Work before us, has never inſerted a doubtful Plant, without mentioning his Scruple, nor any but what he himſelf has ſeen, without an Aſteriſk. He has added to the End of the Work,

thoſe

thoſe which he could with but little Certainty refer to any Claſs; and, contrary to the Practice of ſome late Writers, he never enumerates a Variety, but regards Proportion as a Mark of ſpecifick Difference, if ever a leſs Plant produces Flowers twice as big as a larger Plant of the ſame Species, and holds that Size when planted in Gardens, and continues the Difference to it's Poſterity.

As to the Method and Order of this Work, our Author has been as ſhort, and at the ſame Time as deſcriptive, as poſſible. He has given the Synonymes of moſt good Authors: He generally firſt affixes the Name the Diſcoverer gave it, unleſs a very improper one; and then proceeding uſually as the Authors lived, ſets down the Appellations of *Conrad Geſner*, *Cordus*, *Dodoneus*, *Lobel*, *Tabernemontanus*, *Hortus Aichſtadienſis* of *Baſil*, *Beſler*, *Cluſius*, *Caſpar* and *John Bauhin*, *Moriſon*, *Tournefort*, and others, who have lived ſince them, either as they have diſcovered a new Plant, or illuſtrated an old one with a new Deſcription, Figure, or Character. With regard to Method, he ſays he might have diſpoſed them alphabetically, followed *Boerhaave*'s Method, or *Linneus*'s, but was fearful of making unnatural Diſtortions; eſpecially as he was not writing an univerſal Hiſtory of Plants. He thinks it not at all proper to diſpoſe Plants in the ſame Claſs, unleſs their Affinity is perfect; and lays it down as a Foundation, upon which alone a natural Method can be formed, that however different Plants may ſeem in one Characteriſtick, thoſe ſhould be placed together which agree in moſt others; and however alike they may be in one Point, that thoſe be ſeparated which differ in many others. The Neglect of this Axiom has made all Methods unnatural.

The Author then apologizes for giving new Names to ſome Plants, but he could not omit inſerting ſome that were more expreſſive, and give them the Preference to old ones, that imported little or nothing, although they had the Sanction of Antiquity; but he ſcarce ever has changed the generical Names, becauſe amongſt Things that are in themſelves indifferent, Cuſtom ſhould be always complied with; and as all generical Names are arbitrary, ſcarce any can be thought of to contain enough to diſtinguiſh the Plant by; but the ſpecifick Name ought to be a ſhort Definition and Compendium of it's niceſt Differences: And although this may ſometimes be thought too long, the Marks of Difference in many Kinds will not permit them to be contracted.

After he has acquainted the Reader with his Objections, and told his Reaſons, he proceeds to that Part of his Work, which is intituled, *Nomina Scriptorum & Editionum*; and has given a Specimen of his great Erudition in a very laborious and learned Hiſtory of almoſt all Botanical Authors, for more than 2 Centuries: He therein points out their Excellencies and Defects, ſhews which of them were Originals, and which Plagiaries; gives an Account of all their Publications and Editions, and deduces the Riſe and Progreſs of Botany through all it's Stages, from the general Darkneſs of the 15th Century, to the nice

Diſtinctions

Diſtinctions of the preſent Time. This may be eſteemed a very valuable Performance. It may not be improper to exhibit from it, the different Characters of 2 Books in the Author's own Words, whereby ſome Judgment may be formed of the reſt. Firſt, mentioning *Cluſii rariorum Stirpium per Hiſpaniam obſervatarum*, he ſays, "*Cordus* was "reſtored to the World in *Cluſius*. He, with incredible Labour, col- "lected the Plants of *Spain*, *Languedoc*, *England*, the *Alps*, *Auſtria*, "ſome Parts of *Hungary*, and thoſe about *Frankfort*: He afterwards "drew them, and publiſhed their Figures very expreſſively, and with "great Neatneſs. He alone doubled the Number of Plants before "known, although indeed many have been attributed to him, which "are concealed in the Works of *Cordus*, *Aretius*, and *Geſner*." Our Author afterwards, ſpeaking of *Fabregou*'s *Deſcription des Plantes qui naiſſent autour de Paris*, ſays, "Nothing can be more audacious than "this Writer; he often quarrels with good Authors, and obtrudes "upon them long ſince dead, arbitrary Definitions propoſed by him- "ſelf. The Synonymes of his Plants, and the Definitions of his Spe- "cies, are very much confuſed: He takes, with the utmoſt Impu- "dence, the Names of *Vaillant* and *Tournefort*, but with ridiculous "Alterations. Beſides, to my great Abhorrence, he inſerts a very "great Number of Plants moſt certainly exotick, as growing about "*Paris*; and, leaſt any Thing ſhould be wanting to ſpoil this Work, "the typographical Errors are infinite."

Before I give an Account of our Author's Syſtem of Botany, it will be neceſſary to mention the different Parts of Plants, from which other Authors have formed theirs. *Conrad Geſner* was the firſt who diſcovered, that Plants might be diſtinguiſhed into *Genera* from their different Manner of bearing Fruit, as appears by his poſthumous Letters publiſhed by *Camerarius*; but *Ceſalpinus* firſt reduced it into Practice. *Ceſalpinus*, I ſay, *Ray*, *Herman*, whoſe Plan is much improved by *Boerhaave*, and *Knaut*'s Syſtems, are formed from the Fruit; *Tournefort*'s, from the Figure of the Flower; *Rivinus*'s, which is followed by *Ruppius*, from the Number and Equality of the Petals; *Magnol*'s, from the *Calyx*; *Linneus*'s, from the *Stamina*, *Piſtillum*, and Sex of the Flower; and our Author, his principally from the Number and Diſpoſition of the *Stamina*, and likewiſe from the Manner of Fruiting. I have, at the End of this Extract, abridged it according to the Order of the *Claſſes*, *Genera*, and *Species*.

Throughout the Body of this Work, our Author has ranged his Plants after this Method; and when he mentions a particular Plant, he firſt gives the generical Name, and it's Inventor; then lays down the Form of the Flower, and the Manner of diſtinguiſhing this Plant from others of the ſame Species; then quotes the Synonymes, then the Place of it's natural Growth, afterwards the Deſcription of it's Root and Leaves; and laſtly, collects all the Evidence on both Sides, with regard to it's Uſes as a Medicine, or the contrary. I think it not improper

to

to give here Part of the Hiſtory of one Plant, as a Specimen of the reſt. The Author, ſpeaking, *p.* 298, of *Veratrum*, or *white Hellebore* of the Shops, after mentioning the generical Name, Form of the Flower, 29 Synonymes of different Writers, the Place of Growth, and the Form of it's Root, ſays, "This Plant is univerſally agreed to be "hurtful, though *Braſſavola*, *p.* 531. found ſome People hardy enough "to give ʒj at a Doſe, without any Corrector; which Doſe even *Welſch* "and *Herman* have allowed in Infuſion to Dæmoniacks, alſo *Matthio-* "*lus*, *p.* 1222. with good Succeſs, to Lunaticks. *Herman* in like "Caſes gives the Root in Subſtance, from 15 to 30 Grains. Notwith- "ſtanding which, we find in the *Ephemerides naturæ curioſ.* Anno 1^mo "Obſ. 65. that ℈j has certainly produced Convulſions; and *Wepfer* "mentions a Dog killed with the ſame Doſe, and *Fallopius de Purgant.* "likewiſe many ſtrangled therewith. *Lentilius*, *p.* 868. takes Notice "of violent Vomitings occaſioned by the Root's being given by Miſtake, "inſtead of *Solomon's Seal.* The *Acta Hafn.* Anno v. Obſerv. 55. ſay, "that thoſe moſt hardy Mortals, who live in the Northern Parts of "the World, and purge themſelves with this Plant, receive great Miſ- "chief in their Eyes therefrom, even ſometimes to be followed by "Blindneſs. See alſo it's terrible Effects in the *Breſlau Tranſactions*, "Anno 1725. Even amongſt the Ancients, notwithſtanding that both "Sorts of *Hellebore* were produced in *Anticyra*, the black was only "made uſe of in Purges, on account of the emetick Quality of the white. "See *Pauſanias*, Lib. X. *p.* 623. *Alleyne* will ſcarcely admit it to be "ſafe given in Powder as a Sternutatory. But if the Juice of this "Plant, with it's full Powers, ſhall by any Method get into the Blood, "it is ſo quick a Poiſon, that the Animal immediately dies, if wounded "even in a ſlight Manner, and the Juice applied thereto. See *Crato*, "Epiſt. II. *p.* 226. *Matthiolus* found this Experiment true upon Hens. "See *p.* 1226. *Epiſtolar. p.* 219. And that the Putrefaction excited "thereby was ſo great, that the Fleſh immediately was grown ſoft. "See *Arceus de Curand. Vuln.* Lib. I. *p.* 70. Nor does the Cauſe ſeem "to be obſcure, ſeeing that the Roots, being chewed, fire the Mouth "and Throat, and pour forth a very ſharp Liquor, not unlike that of "Lime. *Geoffroy de Mat. Medic.* Vol. II. *p.* 226. But *Conrad Geſner*, "in the Work publiſhed by himſelf, aſſures us, that his *Oxymel Ellebo-* "*ratum* may be given to ʒij without any Miſchief, and that it is very "uſeful to promote the *Menſes*, Expectoration, and Sweat."

This may ſerve as a Specimen of our Author's great Induſtry and Exactneſs; which he adheres to throughout the whole Work, where a Plant has by any, whether ancient or modern, medical Writer or Hiſtorian, been celebrated for medicinal Purpoſes, or it's Uſes in the Art of Dying. His Deſcriptions are ſo exact, that it is almoſt impoſſible, that any Perſon, ever ſo little converſant with Botany, ſhould miſtake one Plant for another. His Figures, of which there are 24 Tables, are finely engraven, and with great Accuracy, as appears from comparing

them

them with their Deſcriptions. His Method is very natural, and not difficult to comprehend when conſidered; though at firſt View it ſeems more ſo than *Ray*'s, *Tournefort*'s, or *Boerhaave*'s: And indeed there have been already ſo many Botanical Syſtems, ſuch warm Controverſies among Authors, ſo many bad Names, ſuch great Confuſion, that as often as there appears a new Syſtem, it ſends forth a Panick throughout the Botanical World; as it adds to the Number of Names already too great, and tends to the Diſcouragement of thoſe who are deſirous of being acquainted with Plants. But our Author's Syſtem being, as I ſaid before, very natural, and as he gives but few new generical Names, and at the ſame Time when he gives his own, mentions thoſe of moſt good Authors; theſe Conſiderations take off many Objections, to which ſome late Botanick Writers are liable. In the Work before us, the Author takes in only the Plants of *Switzerland*; but I believe his Plan may be extended to a general Hiſtory, which, if executed with the ſame Accuracy as the preſent Work, cannot but be a moſt valuable Performance.

Conſpectus Methodi PLANTARUM *D.* Alb. Halleri.

Plantæ,

I. Sunt vel, flore ſtaminibus & petalis deſtitutæ, ſemine ſolo donatæ; ut *Conferva*.

II. Staminibus veris & petalis deſtitutæ, flore aliquo & ſemine donatæ
- 1. Staminibus omnino nullis, ut *Lichen*.
- 2. Staminum analogis corpuſculis præditæ, ut *Muſci*.
- 3. Epiphylloſpermæ; ut *Oſmunda*, *Polypodium*.

III. Petalis deſtitutæ, ſemine, flore, & veris ſtaminibus donatæ,
- 1. Staminibus coalitis a fructu remotis, coniferæ, ut *Larix*.
- 2. ——— a fructu remotis, Juliferæ; ut *Salix*.
- 3. Non Juliferæ, iſoſtemones; ut *Rhamnoides*.
- 4. Meioſtemones; ut *Alchimilla*.
- 5. Diploſtemones; ut *Knawel* Raii.
- 6. Polyſtemones; ut *Tithymalus*.
- 7. Aquaticæ variæ; ut *Chara*, *Limnopeuce*.
- 8. Triſtemones, flore plerumque bifolio; ut *Gramina*.
- 9. Graminibus adfines; ut *Cyperoides*.

IV. Seminibus, flore, ſtaminibus, & petalis, donatæ.

1. Monocotyledones,
   - 1. Tuba deſtitutæ, Orchideæ; ut *Orchis*, *Helleborine*.
   - 2. ——— præditæ, Liliaceæ,
     - 1. Fructu ſub flore triſtemone, ut *Gladiolus*.
     - 2. ——— hexaſtemone, ut *Colchicum*.
   - 3. Fructu intra florem,
     - 1. Monopetalum; ut *Muſcari*.
     - 2. Hexapetalum;
       - 1. Solitarium; ut *Lilium*.
       - 2. Conglomeratum; ut *Cepa*, *Porrum*.

2. Dicotyledones petalodeæ.
   - 1. Polyſtemones,
     - 1. Plerumque multifiliquæ; ut *Veratrum*, *Butomus*.
     - 2. Gymnopolyſpermæ,
       - 1. Petalis circa ovarium ortis; ut *Adonis*, *Trinitas*.
       - 2. ——— e calyce ortis; ut *Caryophyllata*.
     - 3. Pomiferæ,
       - 1. Umbilicatæ, ut *Ribes*, *Roſa*.
       - 2. Non Umbilicatæ; ut *Prunus*, *Ceraſus*.
     - 4. Multiloculares; ut *Tilia*, *Helianthemum*.
     - 5. Staminibus coalitis; ut *Malva*.
   - 2. Diploſtemones; ut *Oxys*, *Geranium*.
   - 3. Iſoſtemones,
     - 1. Placentiferæ,
       - 1. Vaſculiferæ; ut *Evonymus*.
       - 2. Flore fructui innato Gymnodiſpermæ; ut *Umbelliferæ*.
     - 2. Flore fructui innato,
       - 1. Dipetalo; ut *Circæa*.
       - 2. Tetrapetaloide; ut *Aſperula*.
       - 3. Quinquefido; ut *Opulus*.
     - 3. Flore circa fructum poſito.
     - 4. Cucurbitaceæ; ut *Bryonia*.
     - 5. Solanaceæ; ut *Alkekengi*, *Solanum*.
     - 6. Aſperifoliæ; ut *Echium*, *Symphytum*.
     - 7. Dicarpæ; ut *Aſclepias*, *Pervinca*.
     - 8. Hexapetalæ; ut *Berberis*.
   - 4. Meioſtemones; ut *Liguſtrum*, *Veronica*.
   - 5. Staminibus ad petala ſeſquialteris;
     ut *Tetrapetalæ Cruciatæ*
     - 1. Siliqua breviori,
       - 1. Uniloculares.
       - 2. Biloculares.
     - 2. ——— longiori.
   - 6. Staminibus ad petala duplis ſeſquitertiis; ut *Papilionaceæ*.
   - 7. Flore monopetalo, ſtaminibus quatuor inæqualibus,
     - 1. Capſula uniloculari; ut *Orobanche*.
     - 2. ———Biloculari; ut *Digitalis*.
     - 3. Seminibus quatuor nudis.
   - 8. Floribus uni ſemini inſidentibus congregatis; ut *Pappoſæ*, *Capitatæ*, *Corymbiferæ*.

H. The

The Settling of a new Genus of Plants, called after the Malayans, Mangoſtans; *by* Laurentius Garcin, *M.D. F.R.S. Tranſlated from the* French *by Mr* Zollman, *F.R.S.* No. 431. *p.* 232. Jan. *&c.* 1734.

II. The *Mangoſtans* is a Kind of pomiferous Tree, which grows in the *Molucca* Iſlands, the Fruit of which is one of the beſt in the World for eating.

Character. This *Genus* has it's Flower compleat, tetrapetalous, regular, hermaphrodite, containing the *Ovary*. It's *Calix* is monopetalous, divided into four Lobes, roundiſh on the Edges, and hollowed in the Shape of a Spoon. The *Ovary* is very near cylindrical, with a Tube upon it cut out in the Shape of a Roſe, which covers it like a little Cap. The *Stamina* which ſurround it, are ſpherical at the Top, their Number is four Times that of the *Petala*. When theſe are gone off, the *Piſtil* changes into a round Fruit, adorned with it's *Calix*, and it's Tube, cut into the Shape of a Star, with Rays ſquared at the Corners. It's *Cortex*, which is thick and brittle, encloſes a Cavity filled with as many pulpous and juicy Segments as there are Rays in the Tube. Theſe Segments are white, in the Shape of a Half-moon, ſticking together, and containing each but one Grain of Seed; which latter is oblong, ſomething flattened, reſembling an Almond, wrapped up in a *Tunica*, which is covered with a hairy Coat of Fibres or Veſſels, which, together with the Pulp, make up the *Parenchyma* of a Segment of the Fruit. The Leaves of the Tree are entire, ſmooth like thoſe of the *Laurel*, and grow oppoſite to each other on the Branches. The Stem of the Tree grows up ſtraight to the Top of it's Tuft, and it's Branches and Twigs come out oppoſite to one another like the Leaves.

I know but one Species of this *Genus*, which admits indeed of ſome Variation, but without any other Mark than what appears in the Fruit.

Mangoſtans Garciæ, Cluſ. Bont. *Arbor peregrina Aurantio ſimili fructu. Cluſ. exot.* 12. *Laurifolia Javanenſis C. B. Pin.* 461.

Deſcription. The *Mangoſtans* is a Tree of a very moderate Size. It does not grow above 3 Toiſes (about 18 Feet) high. It's Stem runs up ſtraight to the Top of it's Tuft, like the Fir. This Tuft is regular, in Form of an oblong Cone, compoſed of many Branches and Twigs, ſpreading out equally on all Sides, without leaving any Hollow.

The Stem grows at Bottom to the Thickneſs of a Man's Thigh, or about 8 or 10 Inches in Diameter; it afterwards diminiſhes in Thickneſs by Degrees up to the Tuft. It's Wood is white, as long as the Tree is growing, but browniſh when the Tree is cut down and dry. It's Bark is a little tender, and ſeparates eaſily from the Wood; it is of a dark-grey Colour, and ſlit, or full of Cracks up the Stem, but on the Twigs it is more even and greener, reſembling that of *Euonymus*, or Spindle-Tree.

The Branches grow out of them by Stories, and oppoſite to one another; thoſe Stories croſs each other obliquely, and not at right Angles. The Thickneſs of thoſe Branches is always proportionable to that of the Stem at the Place where they come out of it: This Proportion is about 1 to 4, or 1 to 5. The Length of the inferior Branches

of the Tuft is of 5 or 6 Feet, the others ſhorten as they come near the Top. The Diſtances of the Stories of the Branches are a little unequal, but where they are wideſt, they do not exceed the Length of the greateſt Leaves, that is, 8 or 9 Inches.

The Twigs grow on the Branches in the ſame Order as thoſe do on the Stem, that is, oppoſite to each other. The longeſt are commonly of the Length from one's Hand to the Elbow. The greater Twigs grow out to a certain Diſtance from the Stem, and the others which garniſh the reſt of the Branches, always grow leſs and leſs towards their Extremity.

The Branches and Twigs never divide themſelves.

The Leaves are large, entire, beautiful, ſmooth, of a ſhining Green on the upper Side, and of an Olive Colour on the Back, pointed at their Extremities. The Rib which divides it's Extent into 2 equal Parts, is ſtraight, and equally prominent on both Sides. From the Sides of this Rib there iſſue forth Fibres pretty ſmall, and almoſt by Pairs, which extend themſelves in Parallels, and bent a little Archwiſe quite to the Edge of the Leaf, where they unite themſelves into a Thread, which forms there a Kind of Margin. The Maſhes or Filaments of the Net are not very perceptible. The Size of theſe Leaves varies; the largeſt are 8 or 9 Inches long, but commonly 7. The Breadth of each Leaf is near equal to half it's Length, which Proportion is always the ſame in every Leaf. Their Pedicles are thick, ſhort, and wrinkled, flat on the Inſide, and raiſed in the Shape of an Aſs's Back on the Outſide, moſt frequently half an Inch long. They come out near, and on the Extremities of, the Twigs, oppoſite to each other like the Branches themſelves. There appear ſeldom above 2 Pairs of Leaves on each Twig, and thoſe that ſhoot out laſt always make up the Extremity of that Twig.

The Flower is 2 Inches in Diameter, pretty much like a ſingle Roſe. It is compoſed of 4 *Petala*, almoſt round, or a little pointed, of the Breadth of an Inch, or thereabouts, very thick, firm, fleſhy, brittle, and ſomewhat hollowed into the Shape of a Spoon. Their greateſt Thickneſs is near their Baſis, of above a Line, which decreaſes by Degrees towards the Extremity. They entirely reſemble the *Petal* of a Roſe, except that inſtead of being indented like a Heart, they end gradually into roundiſh Points (as I ſaid before). Their Colour is alſo like that of a Roſe, except that it is deeper and leſs lively. The Baſis, which is the thickeſt and firmeſt Part of it, is the whiteſt, and the moſt brittle.

The Piſtil, or *Ovary*, is a round or almoſt cylindrical Body, five Lines thick, raiſed to the Height of four. The upper Part of this Piſtil, that is to ſay, it's Tube, is cut in the Shape of a ſmall Roſe, covering the *Ovary* like a Cap. The Diameter of this Cap is of an equal Breadth with the *Ovary*, which it covers entirely, ſticking very

cloſe

cloſe to it. The Colour of the *Ovary* is a pale or whitiſh Green, and that of the Tube a White that is ſullied or dirty.

The *Stamina* riſe from the Baſe of the *Piſtil*, they are whitiſh, round at the Tops, and raiſed to the Circumference of the Tube, applying themſelves to the *Ovary*. They are 16 in Number; 4 for each *Petal*.

The *Calix* is of one Piece, expanded and cut into 4 Lobes down to it's Baſis. Theſe Lobes are thick, round, ſkinny, hollowed in the Manner of a Spoon, reſembling alſo *Petala* of Roſes not fully blown. They ſeem to croſs one another like the *Petala*. The two upper Lobes are ſomething larger than the lower ones; they are greeniſh on the Outſide, and of a fine deep Red within, which makes them more agreeable to the Eye than the *Petala*; the Red of the upper ones is more lively than that of the lower ones. All theſe Lobes in ſhort are hollower than the *Petala*; they do not cover thoſe latter farther than half Way their Height. This *Calix* encloſes all the Parts of the Flower. It is ſupported by a Pedicle of 7 or 8 Lines long, it's Thickneſs being commonly of $\frac{1}{3}$ of it's Length. This Pedicle is green, and conſtantly comes out of the End of a Twig above the laſt Pair of Leaves.

The Fruit is round, of the Size of a middling Orange: It's Bigneſs however varies very much, from 1 $\frac{1}{2}$ Inch to 2 $\frac{1}{2}$ Inches Diameter. The Top of it is covered with a Sort of Cap emboſſed, cut out in the Shape of a Roſe, or a Star with Rays ſquared off, of a Finger's Breadth, or ſometimes of an Inch in Diameter. The Rays of this little Roſe are moſt frequently 6 or 7 in Number, but ſeldom of 5 or 8. Theſe Rays, by being thus ſquared, form together a Kind of *Polygon*: This is the Part which had ſerved for the *Tube* to the *Ovary*.

The Body of this Fruit is a *Capſula* of one Cavity, compoſed of a thick Shell, brittle, a little like that of a *Pomegranate*, but ſofter, thicker, and fuller of Juice. It's Thickneſs is commonly of 3 Lines: It's outer Colour is of a dark-brown Purple, mixed with a little Grey and dark Green; the inner Colour, that is to ſay, on the Inſide of the Caſe, is of a Roſe Colour. It's Juice is purple. Laſt of all, this Skin is of a ſtyptick or aſtringent Taſte, like that of the *Pomegranate*; nor does it ſtick to the Parts of the Fruit it contains. The inner Part of this Fruit is a furrowed Globe divided into Segments, much like thoſe in an Orange, but unequal in Size, which do not adhere to each other. The Number of theſe Segments is always equal to that of the Rays of the Tube which covers the Fruit. The fewer there are of theſe Segments, the bigger they are. There are often in the ſame Fruit Segments as big again as any of thoſe that are on the Side of them: Which will be eaſily ſeen in the Figure I have given of it.

Theſe Segments are white, a little tranſparent, fleſhy, membranous, fibrous, full of Juice like Cherries or Raſberries, of a Taſte of Strawberries and Grapes together. Each of the largeſt Segments encloſes a Grain of Seed of the Figure and Size of an Almond ſtripped of it's Shell, having a Protuberance on one of it's Sides, which is nothing elſe

but

but it's Navel. This Grain is covered with two ſmall Skins, the outermoſt of which ſerves for a Baſis to the Filaments and Membranes of which the Pulp is compoſed. The Subſtance of theſe Grains comes very near to that of Cheſnuts as to their Conſiſtency, Colour, and aſtringent Quality. The *Calix* always remains ſticking to the Fruit, to which it ſerves for an Ornament, and when half dried up, it is of the Colour of the *Pomegranate*-Shell on the Outſide. It covers about ⅛ Part of the Circumference of the Fruit.

Remarks. *Garcias*, *Cluſius*, and *Bontius*, are the firſt Authors who have made mention of the *Mangoſtans*; but they have left us only indifferent Deſcriptions, and ſo ſhort ones, that it is not poſſible to form from them a ſufficient Idea for diſcovering it's Characters. The firſt of thoſe Authors was ill informed, when he was told the Fruit of it was yellow. *Cluſius* has ſpoken of it under 2 different Names, without apprehending that it was one and the ſame Plant. The Figure which he has given of the Fruit, and which he calls *Arbor peregrina Aurantio ſimili fructu*, though ill done, yet repreſents it enough to know it again. If in that Figure the Fruit appears little in relation to the Twig which ſupports it, this can be for no other Reaſon, but becauſe he received from the *Indies* ſome of that Fruit which had been gathered before it's State of Perfection, and after it drew his Figure. And hence it is, that the Fruit being ſhrunk up and imperfect, he found nothing in it but a few ſhrivelled Grains, which were not much larger than thoſe of a *Fig.*

It is ſurprizing however, that the moſt delicious Fruit of all the *Indies*, and which yields to none of the beſt in *Europe*, is that which of all has been hitherto leaſt known. But as I have often eaten of it, and found it as excellent as it is reputed in the Countries where it is cultivated, I reſolved to examine it's Genus, to ſettle it's Characters, and to give a Deſcription of it, which might make it better known for the future to Botaniſts, and other curious Perſons.

This Tree originally grows in the *Molucca* Iſlands, but for ſome Years paſt it has been tranſplanted into the Iſle of *Java*, and ſome few at *Malacca*, in which Places it thrives very well. It's Tuft is ſo fine, ſo regular, ſo equal, and the Appearance of it's Leaves ſo beautiful, that it is at preſent looked upon at *Batavia* as the moſt proper for adorning a Garden, and affording an agreeable Shade; yet there have been but few *Europeans* in the *Indies* who have made uſe of it for this Purpoſe, becauſe they were unacquainted with it. They employed other Trees which did not near come up to it as to Uſefulneſs and Beauty.

Travellers who make mention of it's Fruit, always ſpeak of it with great Encomiums. *Linſchooten* is the only one who, after having given a Deſcription of ſeveral *Indian* Fruits in his own Way, thought it needleſs to deſcribe the *Mangoſtans*, as well as ſome others, becauſe, ſays he, they are little valued. Probably he never ſaw it, but upon Enquiry took upon Credit what ſome Perſon or other told him, who knew

knew nothing of it beſides the Name, and confounded it with others which are little eſteemed.

There are few Grains to be met with in this Fruit that are good for planting, for moſt of them are but abortive.

Sometimes this Fruit is found ſpoiled within, which may be known by yellow Spots appearing on ſome of the Segments. Some People ſcruple then to eat them, but others make no Difficulty about it. It is certain however, that they are not ſo good, eſpecially if the Spots are conſiderable. I obſerved that this Corruption proceeded from the Juice in the *Capſula*, which being ſpoiled by the Sting of ſome Inſect, and thereby becoming yellow, and ſpreading over the Segments of the Fruit, infected them with that Colour, and thereby changed them. This Wound is ſo ſmall, and ſo hard to be diſcovered, that one often is left in a Doubt whether there be any at all.

One may eat a great deal of this Fruit without any Inconvenience, and it is the only one which ſick People may be allowed to eat without any Scruple. It is very wholſome, refreſhing, and more cordial than the Strawberry.

It's Shell has the ſame Virtue as that of the *Pomegranate*; at *Batavia* they make an Infuſion and a Tincture of it againſt Looſeneſſes, and chiefly againſt Dyſenteries. The Wood is good for nothing but firing.

In the *Mem. de Math. & de Phyſ. de l'Acad. R. des Sc. de Paris*, 1692, Page 435, *Amſt.* Edit. there is a ſhort Deſcription of the *Mangoſtans* by Father *Beze*, which is pretty good; but as he took the *Calix* for the Flower, it is plain he obſerved it not until after the *Petala* were fallen off. His Deſcription is too ſhort and defective for determining from thence alone the true Characters of this Genus.

Explanation of the Figures.

Fig. 51. The Flower as it appears in the Inſide and Outſide. *a.* The four *Petala* of the Flower. *b.* The four Lobes of the *Calix*. *c.* The Tube. *d.* The *Pedicle*. Fig. 51.

Fig. 52. The *Calix* as it appears in the Inſide with the *Piſtil* and the *Stamina*: *e.* The End of the Pedicle of the Flower, which ſupports the *Calix*. Fig. 52.

Fig. 53. A *Petal*, as it appears on the Back, ſeparated from the Flower: *f.* It's Baſis, which is the thickeſt, the firmeſt and the moſt brittle Part. *g.* Four *Stamina* belonging to the *Petal*, ariſing from the Baſis of it, and of the *Piſtil*. Fig. 53.

Fig. 54. The entire Fruit ſeen from the Side of the *Calix*, or the *Pedicle*. *h.* The *Calix*: *i.* The *Pedicle*. *k.* A Part of it's Tube. Fig. 54.

Fig. 55. The ſame, ſeen from the Side of the Tube, which is cut out in the Shape of a ſmall Roſe: *l.* The Tube, which always ſticks faſt to the Fruit. *m.* The *Pedicle*, and Part of the *Calix*. Fig. 55.

Fig. 56. The Fruit cut into two Halves, containing 6 Segments: *n.* The Segments good to eat, whereof ſome commonly are larger than the others. *o.* The *Calix*. *p.* The *Pedicle*. Fig. 56.

Fig. 57.

Fig. 57. *Fig.* 57. A ſeparate Segment of the Fruit, in the Shape of a Half-moon, containing a Grain.

Fig. 58. *Fig.* 58. A Grain or Seed ſeparated from the Segment, the Coat whereof is covered with Filaments, which formed the *Parenchyma* of the Segment.

Fig. 59. *Fig.* 59. A Leaf of the Tree which bears the *Mangoſtans*, with it's Fellow cut off near the Bottom, ſupported by a Piece of it's Twig.

Botanical Obſervations, exhibiting accurate Deſcriptions of ſome Plants, by Paul. Henry Gerard Moehring, *M. D.* No. 454. *p.* 211. July, *&c.* 1739.

III. 1. *Salicornia ramis clavatis, ſquamis articulorum adpreſſis.*

It is an annual Plant, ſucculent in all it's Parts, 8 or 9 *Rhinland* Inches, ſeldom a Foot high. The Root is fibrous: The Stalk is branched, a little flatted, woody, and wrinkled at the Root, ſucculent above, ſmooth, without Leaves, having Clubs proceeding alternately from auricular, ſquamous Productions, forming Sheaths, and flatted cloſe to the primary Stalk; they are from ½ to 1 ½ *Rhinland* Inches long, the extreme one being longer than the reſt.

The Fructification conſiſts of 3 little Flowers, of the Form of a birectangular ſpherical Triangle, with the baſe Convex upwards, and diſpoſed alternately. It ſits upon each Joint of the Branches, which is ſquamous, denticulated, and ſomething acute, the Indentation ſerving for a Receptacle of the whole Fructification, and incloſing the loweſt *Stamina*. The Empalement is a ſquamous Production of the Stalk, forming one Plane with it, when it withers. That of the upper, and as it were intermediate Flower, is rhomboidal, the inferior rectilinear Angle being acute, the upper curvilinear one obtuſe: That of the 2 lower, or, if you pleaſe, lateral Flowers is triangular, the Baſe being a little broader.

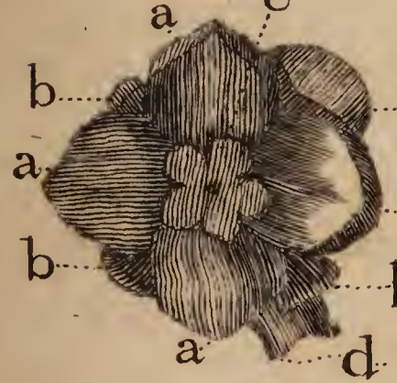
It has no *Corolla*. There are 2 *Stamina*, placed oppoſite above and below the *Germen*, fixed to it's Baſe, and coming out of the Opening of the Empalement: The firſt riſes up, and when that falls, the under one comes out; whence all the Botaniſts have aſcribed but one *Stamen* to it. The *Filamenta* are like Threads, and lie within the Empalement. The Summits are oblong, erect, appearing out of the Empalement, doubled, ſo that at the firſt nice Inſpection they repreſent a ſmall quadrangular Body, hollow without, having their Sides rolled inwards longitudinally, with a Filament or Chive of equal Length, adhering to the Top of it on both Sides, and covering it cloſely, having their Baſe ſhut up for the moſt Part within the Cavity of the Empalement. A great Quantity of the genital *Farina* falls into that Cavity.

The *Piſtillum* is a roundiſh, pointed Bud, placed between the Chives, and hid within the Empalement, of the ſame Length with the Chives. It has no Style. It's *Stigma* is capillary and acute.

The *Pericarpium* is a Veſſel blown up like a Bladder, of an acuminated oval Shape, exactly reſembling the Hood of the *Polytrichum Dillenii*, only more ſwelling downwards, and hid within the Empalement. It has one Seed, of a flat oval Shape, placed horizontally in the Veſſel,

furrowed

51



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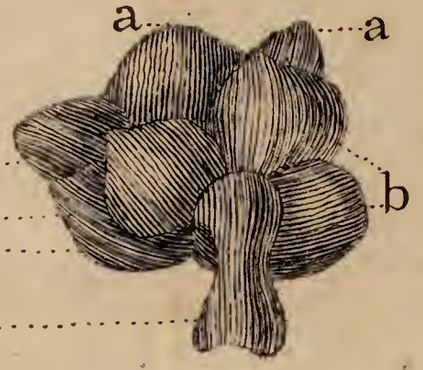

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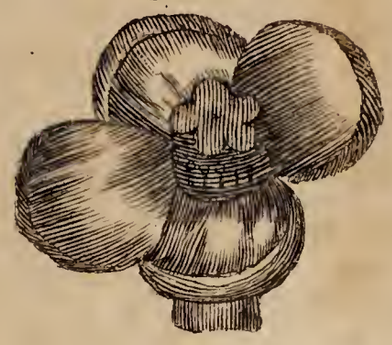

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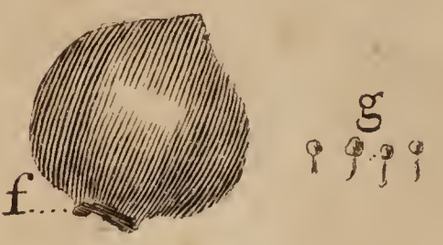

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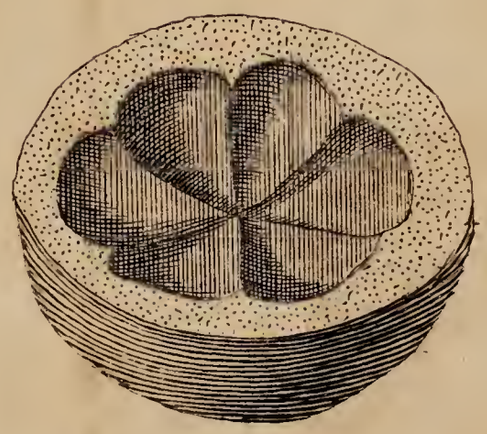

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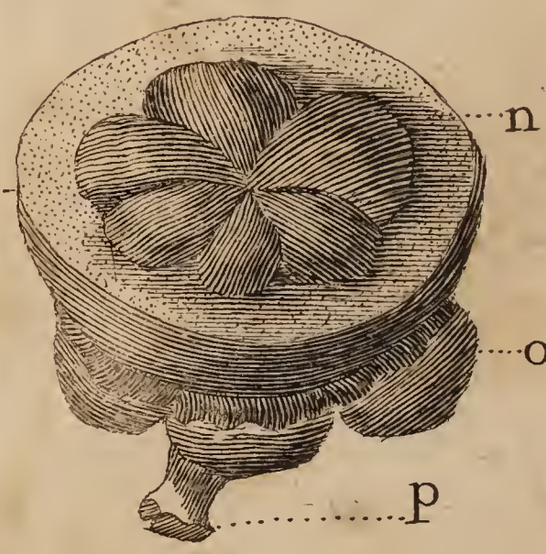

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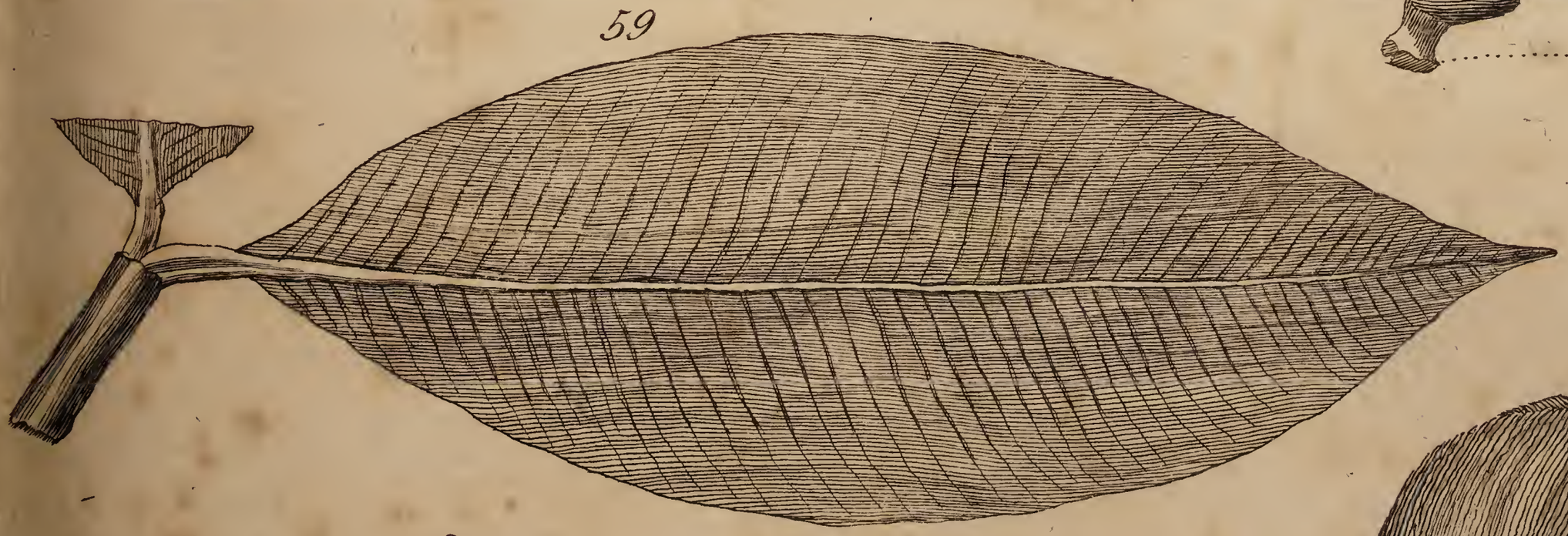

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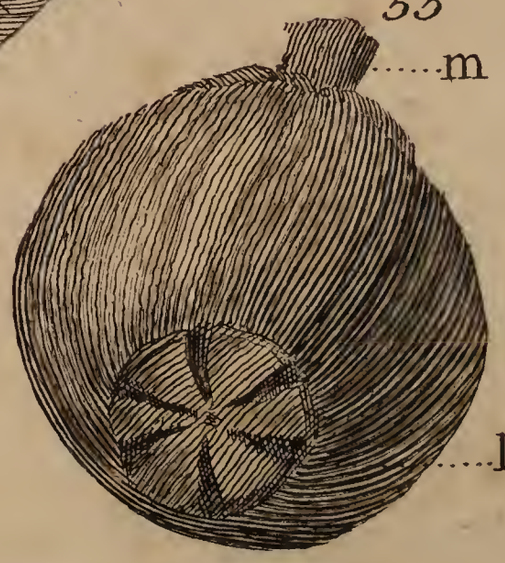

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57

Mangostans.

furrowed from the Baſe to the Middle, and fixed to the Rib of the Stalk by a very ſmall Pedicle.

Obſervations. a. It grows commonly on the Shoar of the N. Sea, where the Soil is a fat Clay, ſuch as we call *Schlick*, and ſometimes ſprinkled with the Salt Water. But as ſoon as the Earth is banked in, and deprived of the Nouriſhment of the Sea Salt, it diſappears in a Year's Time.

b. It is uſed in Sallads, having a cooling Taſte.

c. It flowers in *Auguſt*, and ripens it's Seeds in *Sept.* and *Oct.* The young Plants come up in *April*, and the Beginning of *May*. The Seed-Leaves are round, oblong, and ſucculent.

d. Therefore, in *Linnæus*'s *Syſtema Sexuale*, it belongs to the *Diandria Monogynia.*

e. There is another Species, of which a dried Specimen was ſent me from *Saltzdahl* in the Dutchy of *Brunſwick*, by Dr *Franc. Ern. Bruckman*; it is very different from ours, and may be called *Salicornia, ramis imbricatim pyxidatis, ſquamis articulorum extantibus.* It ſeems to have been mentioned by ſeveral Authors.

f. Laſtly, it appears, that the *Genus* of *Salicornia* has not hitherto been explained with ſufficient Accuracy by any Botaniſt, witneſs *Linnæus*'s Fragment, in his *Charact. Gener. Plant. & Hort. Cliffort.* where he relates only the imperfect Sketches of *Tournefort* and *Magnol.*

2. *Verbaſcum foliis cordatis crenatis acutis glabris : floralibus ternis.*

It is a biennial Plant, flowering the ſecond Year. It's Stalk is 7 or 8 Feet high, generally ſingle, ſometimes branched at the Bottom, very long, upright, round, covered with very ſhort Hairs, of a lively Green, full of Leaves toward the Bottom, but towards the upper Part, where the Flowers begin to break forth, it is ſet with ſmall *Foliola.* The Leaves of the firſt Year, and the lower ones of the Stalk, are ſeſſile, half embracing the Stalk, ending in a Point, ſmooth, crenated, and indented, the Indentations being unequal.

The *Floralia* are 3, pointed, ſmall, the middle one being twice or thrice as long as the lower one. The Flowers are generally 4 out of the ſame Boſom; one at the Top of the Stalk, the reſt ſuffocated. The *Pedunculus* is much ſhorter than the Empalement, thick and ſingle. The Empalement as in *Linnæus*, cut into 5 at the Baſe; the Diviſions being pointed and hairy. The *Corolla* as in *Linnæus.* The Chives are pointed, the 3 upper ones being ſhorter than the reſt, hairy all round: The 2 lower ones $\frac{1}{3}$ longer than the reſt, bent upwards, and woolly in the middle of the inner Side. The *Summits* of the 3 ſhorter Chives are flat, plain, and ſexangular, lying upon them in a triangular Form; thoſe of the 2 longer Chives lie in a rectangular Figure, being alſo flat, plain, and ſexangular. The *Piſtillum* is a roundiſh Bud. The Style like a Thread, bending, a little longer than the Chives. The *Stigma* as in *Linnæus.*

The *Pericarpium* is a ſub-globous Veſſel, having 2 Furrows from the Bottom to the Top, and divided into 2 Cells, *&c.* as in *Linnæus*. The external Covering of it is an upright Empalement, embracing the Fruit. The Seeds are numerous, oblongo-quadrangular, truncated, moſt minutely wrinkled, and ſmall. The *Receptacula* as in *Linnæus*.

Obſervations. a. Therefore as to moſt of the Parts of Fructification, it is very like the fifth *Verbaſcum* of *Linnæus*, *Hort. Cliff. p.* 55. In the reſt it differs.

b. The Petals are yellow, their Nails being ſpotted with Purple. The Chives are purple within: Their Down is partly purple, and partly white.

c. The Seeds were ſent me by my Friend Dr *Linnæus* in 1738, under the Title of *Verbaſcum e Virginia*; and produced the Plants now deſcribed. They ſeem to want only houſing in the Winter.

d. The Flower is open all the Morning the whole Summer.

e. Therefore the *Verbaſcum annuum, foliis oblongis ſinuatis obtuſis glabris Linn. Hort. Cliff.* 55. would be better named *Verbaſcum foliis oblongis ſinuato-crenatis obtuſis glabris, florali unico:* The chief ſpecifical Difference of which is, that it has but one floral Leaf, ovato acuminated; one Flower; a very long *Pedunculus*, like a Thread, three Times as long as the Empalement; and a plain expanded Empalement under the Fruit.

3. *Senecio foliis pinnatifidis lacinulatis: Laciniis omnibus laxis patentiſſimis linearibus acutis. Jacobæa altiſſima, foliis Erucæ Artemiſiæve ſimilibus & æmulis* Rup. Jen. 142.

The Stalk is as tall as a Man, round, or very ſlightly angular, ſlender, and ſmooth. The Leaves are alternate, pennatifid, ſmooth, with the Segments linear, very wide, looſely laciniated, ſharp at the Point, ſet on a linear Rib: They are of a deep green Colour, ſomething paler at the lower Part.

The Rays of the Flower are yellow, and rolled back; the Leaves of the Empalement are preſſed to the reſt at the Baſe.

Obſervations. a. I have called this Plant a *Senecio* according to *Linnæus Gen. Plant.* 647.

b. It differs therefore in Species from *Linnæus*'s *Senecio foliis pinnato-lyratis, lacinulatis* Hort. Cliff. 406.

4. *Illecebrum* Lin. Coroll. Gen. 947. Rupp. Jen. 79. *Corrigiola* Dillen. Giſſ. Supp. Append. 167.

The Empalement conſiſts of 5 thick, erect, compreſſed Leaves, hollow on the Inſide at the Top, and enduring. It has no *Corolla*. The *Stamina* conſiſt of 5 Chives triangular and pointed, ſhorter than the Fruit within the Empalement, and round, erect, ſingle Summits. The *Piſtillum* is a ſharp oval Bud, ſhorter than half the Empalement. It has no Style. The *Stigma* is ſingle, turgid, and obtuſe.

The *Pericarpium* is a very thin, oval, membranaceous Veſſel, acuminated on each Side, ſingle, univalve, gaping at the Top, and covered by

by the Empalement. It has one very large, ſhining, oval Seed, acuminated on each Side.

Obſervations. a. Therefore it belongs in *Linnæus*'s *Syſtema ſexuale* to the *Pentandria Monogynia*, and will be placed conveniently after *Achyranthis*, *Genus* 94.

b. I have diſcovered theſe Characters by 3 Years Obſervation of the Plant, which grows plentifully with us in moiſt ſandy Places, where it ſpreads itſelf on the Ground.

5. *Ruppia foliis linearibus obtuſis.*

The Plant ſwims upon the Sea Water; is bending, and perennial.

The Root is ramoſe, ſending forth Bunches of Leaves; the Body of it is round, jointed, creeping, brown, ſolid, about the Thickneſs of a Pigeon's Quill, or ſomething thinner; the Fibres are capillary and ſingle, coming only out of the Joints, 1 or 2 Inches long, and whitiſh.

The Stalks reſemble thoſe of Graſs, and come each out of a Branch of the Root; they are flat, looſely jointed, ſmooth, very weak, bending, floating, and on the Reflux of the Water lying on the Sand, ſending forth compound Branches out of every ſheathed Joint, in an alternate Order.

The ſheathing Leaves are alternate, linear, vertically obtuſe, longitudinally Parallelograms, ſmooth, mucous, deep Green, and with their Baſe fixed to the Joints of their Stalks, cover their Branches, and with their Leaves, like Daffodils. Toward the Extremity of each Branch, 2, 3, or 4 Leaves, placed parallel, are incloſed in one Sheath.

In moſt of the ſheathed Leaves, which are longer than the Stalk itſelf, the Fructifications are hidden in the lower Half, within a compreſſed Opening. Above and below the Line of Fructification, there is a Joint, furrowed tranſverſly, diſtinguiſhing it from the *Petiolus* below, and from the reſt of the Leaf above.

The Empalement is an univerſal Covering, a Sheath ſupplying the Place of a *Spatha*, in the lower Half of the Leaf; it opens in the middle of it's Length, and one Side wraps a little over the other.

The *Spadix* within the *Involucrum* is membranaceous, white, flat, obtuſe, the Sides being a little rolled up longitudinally, the middle having a ſlight *Carina*, looking toward the Back of the *Involucrum*, in Length $\frac{3}{4}$ of the *Involucrum*, or little longer, never reaching the End of it, incloſing from 9 to 13 Fructifications in 2 Rows.

It has neither *Corolla* nor Chives. The Summits are ſolitary, concealed within the Sheath before blowing, ovato-oblong, a little pointed on each Side, aſcending obliquely, and adhering in 2 Rows lengthwiſe to the *Spadix*, in ſuch a Manner, that one *Piſtillum* ſeems to receive ſometimes one, ſometimes two Summits in the ſame Plane; but there is really one *Piſtillum* to each *Summit*, ſometimes hidden, and ſometimes appearing. But being unfolded during the Time of flowering, by their lateral, elaſtick, membranaceous, tranſparent, expanded Wings, they are bent into the hollow Form of a Boat, the Keel being downwards,

and are ſo put over the *Piſtilla*, that the Cavity of the *Involucrum* being opened, their under Part riſes horizontally upwards, and they appear in Form of little Boats lengthwiſe outwards. The Body of the Summits is yellow, and has a *Mucus* upon it, which may eaſily be wiped off.

The *Piſtillum* is a Bud, within the *Involucrum*, oblong, a little larger at the Baſe, where it is fixed to the *Spadix*. The Style within the *Involucrum* is ſimple, filiform, bending upward, enduring, after flowering parallel with the *Spadix*, and a little crooked. There are 2 very thin, capillary *Stigmata*, ſeparated from each other, ſtretched horizontally without the *Involucrum*, ſoon withering and diſappearing; ſo that the duſky ferrugineous Spot remaining may eaſily perſuade any one, that there is but one *Stigma*.

The *Pericarpium* is a thin, membranaceous, cylindrical Huſk, obtuſe at the Baſe, having a Style at the Stop, being a little longer than the Style, parallel with the *Spadix*, free at the Baſe; fixed to the *Spadix* at the End of the Style, by Means of a very ſhort little Pedicle.

In each Huſk there is a ſingle, cylindrical Seed, obtuſe on both Sides, very nicely ſtriated on both Sides, and white.

Therefore it belongs in *Linnæus*'s *Syſtema ſexuale* to the *Gynandria Monandria*, but not at all to the *Gynandria Polyandria ejuſd. ibid.* In the *Fragment. meth. nat. Linn. p.* 506. *Claſſium Plantar.* to the 48th Order, to which alſo *Naias* and *Zanichellia* ſeem to belong. In *Royen*'s Syſtem, to the *Palmæ ſpatha bifida*. See his *Flor. Leyd. Prodr. p.* 9.

It grows in the Salt Water, at the Iſland *Wangeroogen*, and other Iſlands ſituated in the Bay of the Northern Ocean, called *Wadt*. When the Tide comes in, it floats upon the Water; but when the Tide is gone out, it lies upon the tenacious Clay, in which it's Root is fixed.

It is a Wonder, that a Plant ſo common in maritime Places, the Leaves of which, in *Aug.* and *Sept.* are caſt upon the Shoar in great Abundance, has never been either deſcribed or figured, unleſs perhaps by an *Engliſh* Botaniſt. It ſeems to belong to the *Genus* of *Ruppia*, if the Character of it, as given by *Linnæus*, only from a dried Specimen, as the Mark † denotes, but a little enlarged. Should it rather be a new *Genus*?

6. *Hippuris* Linn. Gen. 1.

It has neither Empalement nor *Corolla*.

The *Stamen* is one thick, pointed Chive, deciduous, of near the ſame Length with the Summits, and ſitting on the Bud. The Chive is double, biſulcated in each Segment behind, a little longer than the Bud and Chive, thick and fleſhy.

The *Piſtillum* is an oblong Bud below the Chive. It has one thin, filiform, erect Style, with the Point bending outwards, riſing within, by the Side of the Chive, from the Top of the Bud, longer than the Chive, and withering. The *Stigma* is very ſharp-pointed.

It has no *Pericarpium*; but one, oblong, naked Seed, containing a ſmall Kernel in a hard Shell.

Observations. 1. It flowers in *June* and *July*, and perfects it's Fruit in *Aug.* and *Sept.* It grows plentifully *in fossis Feveranis*, near *Embden* in *East-Friezland*, *&c.*

2. There is a Variety with red Chives, which is more plentiful; and another with whitish herbaceous Chives, which is more rare.

3. Therefore those Margins described by *Linnæus* under the Empalement are really Summits, as appears evidently by a good Glass.

Fig. 60. The Flower seen at the fore Part, that the *Filamentum* or Chive may appear. *a.* The Chive. *b b.* The Summits seen on the fore Part.

Fig. 61. The Flower seen on the back Part, that the *Pistillum* may appear. *c c.* The Summits seen on the back Part, to shew the Furrows. *d d.* The *Germen* or Bud. *e.* The Style with it's Stigma.

Fig. 62. The Seed. *f.* The Seed almost ripe. *g.* The Stile withering, bent above the Seed.

Explanation of the Figures drawn by a good Microscope.
Fig. 60.
Fig. 61.
Fig. 62.

IV. "Whether the *Scurvy-grass* of *Greenland* be the same Species, "as to it's external Appearance, with the common *Scurvy-grass* of "*England?* And, having no acrid Taste while growing in *Greenland*, "doth it, being brought growing in Earth from *Greenland*, gradually "acquire an acrid Taste, as it is brought into a warmer Climate?"

A Query proposed to such curious Persons as use the Greenland *Trade, occasioned by the annexed Letter from Mr* David Nicolson, *Surgeon, to Dr* Mortimer, *Sec.* R. S. No. 456. *p.* 317. Jan. *&c.* 1740.

SIR, *London, Dec.* 16, 1730.

I communicate this as Matter of Truth, and not Hypothetick, *viz.* that the *Scurvy-grass* in *Greenland*, equally the same with ours in *England*, as to the Figure of the Plant, and all it's Appearance to the Eye, changes it's Nature much, as it approaches the Sun; for in that Climate, it's principal Quality, the volatile Salt, is neither pungent nor perceivable; but to the Taste, the whole Plant is entirely as insipid as the Colwort or Beet. So by my Endeavour, I preserved some Plants with their natural Earth, and brought them to *London* alive; and I observed the remarkable Change produced by the Sun's Heat on them; for the saline Matter in *Greenland*, which certainly was analogous to a fixed Salt, became, in a Month's Time, almost to the same Volatility as that which naturally grows in *England*.

This I make mention of, in case other Gentlemen, who have had the same Opportunity, have been remiss in their Curiosity.

David Nicolson.

V. The Tree from which the *Jesuits Bark* is cut, grows in *Peru*, and is found most commonly in the Provinces of *Loxa*, *Ayavaca*, and *Quenca*, which are situated between two and five Degrees of S. Lat. This Tree is tall, and has a Trunk rather bigger than a Man's Thigh, tapering from the Root upwards, has no Boughs or Branches till near it's Top, which grow as regular as if lopped artificially, and with the Leaves form exactly the Figure of a Hemisphere: It's Bark is of a blackish Colour on the Outside, and sometimes mixed with white Spots, whence commonly

An Account of the Peruvian *or* Jesuits Bark, *by Mr* John Gray, *F. R. S. now at* Cartagena *in the* Spanish West-Indies; *extracted from some Papers*

given him by Mr William Arrot, *a* Scotch *Surgeon, who had gathered it at the Place where it grows in* Peru. No. 446 *p.* 81. July, *&c.* 1737.

commonly grows a Kind of Moss, called by the *Spaniards*, *Barbas*; it's Leaves resemble much the Leaves of our Plum-Tree, of a darkish green Colour on their upper or concave Side, and on their lower or convex Side, reddish: It's Wood is as hard as our common *English Ash*, and rather tough than brittle.

There are 4 Sorts of the Bark of this Tree, to which the *Spaniards* give the following Names, *viz. Cascarilla colorada*, or reddish Bark; *amarylla*, yellowish; *crespilla*, curling; and *blanca*, whitish: But Mr *Arrot* could only find two different Sorts of the Tree, and he believes that the other two Sorts of the Bark are owing to the different Climates where it grows, and not to a different Species of the Tree. The Bark called *colorada* and *amarylla*, is the best, and differs from the *blanca* in this, that the Trunk of the former is not nigh so big as that of the latter, the Leaves as described above; whereas those of the *blanca* are larger, and of a lighter green Colour, and it's Bark has a very thick spungy Substance, whitish on the Outside, and is so tough, that it requires the Force of an Ax to slice it from the Tree: It is true, indeed, it is as bitter when cut down as the best Sort, and has then the same Effect in intermitting Fevers; but when dry and long kept, turns quite insipid and good for nothing: And it is to be observed, that both Sorts have a much surer and quicker Effect in Cures when green, than when dry. As the bad Sort is in great Plenty, and the best very scarce and hard to be come at, large Quantities of it are cut yearly, and sent with a little of the fine Bark to *Panama* for *Europe*.

The Tree of the *crespilla* is the same with that of the *amarylla* and *colorada*, but grows in a cold frosty Climate; by which Means the Bark is not only altered in it's Quality, but is also whitish on the Outside, though Cinnamon-coloured within, and ought in Medicines to be rejected. This Sort and the *blanca* grow plentifully in the Province of *Ayavaca*, 50 Leagues from *Piura*, and 62 from *Payta*, a Port in the *South-Sea*; as also in *Cariamango*, *Gonsonama*, and *Ximburo*, whence they commonly send it to *Payta*, and there sell it as the best. The *blanca* likewise grows in the Province of *Quenca*, and in the Mountains of *Caxamarea*: But the true and genuine fine *Jesuits Bark*, which is of a reddish or yellowish Colour, is only found from 5 to about 14 Leagues round the City of *Loxa*, in the Province of *Loxa*, called generally by the *Spaniards*, *Provincia de las Calvas*. This City is situated between two Rivers, that run into the great River *Marannon*, or of the *Amazons*, and lies about 100 Leagues from *Payta*, and in a direct Line about 110 Leagues S E from *Guayaquil*, though by the common Road near 200. The Places about *Loxa*, where this fine Sort is found, are, *La Sierra de Caxanuma*, *Malacatos*, *Yrutasinga*, *Yangana*, *Mansanamace*, *La Sierra de Boqueron*, and a Place called *Las Monsas*.

The Bark-Trees do not grow all together in one Spot, but intermixed here and there with many others in the Woods; it happens, indeed, sometimes, that Clusters of them are found together, though

at

at preſent they are much ſcarcer than in former Times, a great many of the fine large Bark-Trees having been entirely cut down, that their Bark might the more eaſily be ſliced off.

The Soil where the beſt Sort thrives, is generally in red clayey or rocky Ground, and very frequently on the Banks of ſmall Rivers deſcending from high Mountains.

That this Tree flouriſhes and bears Fruit at the ſame Time all the Year round, is certainly owing to the almoſt uninterrupted Rains, that fall in thoſe high Mountains where it grows, which continue with little or no Intermiſſion: Although about 3 or 4 Leagues down in the low Country, where it is exceſſive hot, there are wet and dry Seaſons, as in other hot Countries, the Rains beginning in *December*, and ending in *May*; this Seaſon the *Spaniards* who live there call *Temporal*, and it is general all thereabouts; whereas what they call *Paroma*, is a cold rainy Seaſon, that laſts in all the mountainous Places of theſe Countries from *June* to *Nov.* but eſpecially in the City of *Loxa* and Places adjoining, where Mr *Arrot* has paſſed 25 or 30 Days without ſeeing the Sun once, and felt the Air ſo extremely cold, that he was obliged always to be wrapped up in his Cloak, and to be in continual Motion to keep himſelf warm. Such exceſſive Cold ſo near the Line, appears to *Europeans* incredible; but many Places in theſe Latitudes are ſo, by their Situation and Vicinity to high Mountains.

The propereſt Seaſon for cutting the Bark is from *Sept.* to *Nov.* the only Time in the whole Year of ſome Intermiſſion from Rain in the Mountains. Having diſcovered a Spot where the Trees moſt abound, they firſt build Huts for the Workmen, and then a large Hut wherein to put the Bark, in order to preſerve it from the Wet; but they let it lie there as ſhort Time as poſſible, having before-hand cut a Road from the Place where the Trees grow, through the Woods, ſometimes 3 or 4 Leagues, to the neareſt Plantation or Farm-houſe in the low Country, whither, if the Rain permits them, they carry the Bark forthwith to dry. Theſe Preparations made, they provide each *Indian* (they being the Cutters) with a large Knife, and a Bag that can hold about 50 Pounds of green Bark; Every two *Indians* take one Tree, whence they cut or ſlice down the Bark, as far as they can reach from the Ground; they then take Sticks about half a Yard long each, which they tie to the Tree with tough Withs at proper Diſtances, like the Steps of a Ladder, always ſlicing off the Bark, as far as they can reach, before they fix a new Step, and thus mount to the Top, the *Indian* below gathering what the other cuts: This they do by Turns, and go from Tree to Tree, until their Bag is full, which, when they have Plenty of Trees, is generally a Day's Work for one *Indian*. As much Care as poſſible muſt be taken that the Bark is not cut wet; ſhould it ſo happen, it is to be carried directly down to the low Country to dry; for otherwiſe it loſes it's Colour, turns black, and rots; and if it lie any Time in the Hut without being ſpread, it runs the ſame Riſque: So that while the

Indians

Indians are cutting, the Mules (if the Weather permits) ought to be carrying it down to the Place appointed for drying it, which is done by spreading it in the open Air, and frequently turning it.

Mr *Arrot* had the Curiosity to send above 50 *Seroons* from the Woods to the City of *Loxa*, where he put it into a large open House, and dried it under Cover, never exposing it either to the Sun or Night Air, imagining that the Sun exhaled a great many of it's fine Parts, and that the Night Air, or *Serene*, was very noxious to it; but he found the Colour of the Bark thus cured, not near so bright and lively as that dried in the open Air. He is of Opinion, that a very short Time will put an End to this best Sort, or, at least, it will be extremely hard to be got, by reason of it's Distance from any inhabited Place, the Impenetrability of the Woods where it grows, and the Scarcity of the *Indians* to cut it, who, by the *Spaniards* hard Usage and Cruelty, are daily diminishing so fast, that in a very few Years their Race in that Country will be quite extinct.

Mr *Arrot* says, that the small Bark which curls up like Sticks of Cinnamon, (and which in *England* is much esteemed, as being cut off the Branches, and therefore reckoned better and more effectual in curing Fevers) is only the Bark of the younger Trees, which, as it is very thin, curls in that Manner; and that the Bark of the Branches would not compensate the Trouble and Expences of cutting. He also told me, that after the Bark is cut off any Tree, it requires at least 18 or 20 Years to grow again; which is directly contrary to what Dr *Oliver* says *. He added besides, that it's Fruit is no Ways like a Chesnut, as the Doctor informs us in the same Paper; but rather like a Pod, which incloses a Seed somewhat like a Hop-seed, and that he had sent some of them to *England*.

He could not tell me by what Artifice or Stratagem the *Jesuits* have got this Bark to be called after them, if not that they carried it first into *Europe*, and gave themselves out as the first Discoverers of it's Virtues: But he assured me, that the current Opinion at *Loxa* is, that it's Qualities and Use were known by the *Indians* before ever any *Spaniard* came among them; and that it was by them applied in the Cure of intermitting Fevers, which are frequent over all that wet unhealthy Country.

A Catalogue of Plants observed in the Tyrol Alps *at the beginning of* Sept. *by* Balthazar Ehrard, *M.D.* No. 458. *p.* 551. Sept. *&c.* 1740.

VI. *Acetosa lanceolata, Alpina, rotundi folia N.* Round-leaved Sheeps-Sorrel of the *Alps*.

Acini pulchra species J. B. 3. 260. Broad-leaved *Austrian* wild Basil.

Cacalia tomentosa C. B. 198. Woolly strange Colts-Foot.

Cardamine Alpina Clus. Pannon. *Alpine* Ladies-Smock.

Caryophyllata Alpina Chamædryos folio Boerh. 45. Mountain Avens, with Germander Leaves.

Cotoneaster J. B. 1. 73. Dwarf Medlar.

* Vol. IV. Part ii. Chap. 5. §. 14.

Cratægus

Cratægus folio ſubrotundo, ſerrato, ſubtus incano Tourn. 633. The white Beam-Tree.

Daucus montanus, multifido longoque folio C. B. Mountain Lovage, with a long, divided Leaf.

Dioſpyros J. B. 1. 75. *I. Myrtomelis Geſneri.*

Doria quæ Jacobæa Alpina C. B. Prod. 66. Alpine Doria.

Erica arboreſcens, floribus luteolis vel herbaceis J. B. 3. 356. Beſome Heath.

Horminum luteum glutinoſum C. B. 238. Yellow Clary, or *Jupiter*'s Diſtaff.

Larix folio deciduo conifera J. B. The Larch-Tree.

Chamærhododendros Alpina villoſa T. 604. Hairy Mountain Ciſtus.

Quinquefolium album 1. *Cluſ.* White-flowered Mountain Cinquefoil.

Pinaſter Alpinus pumilio Cluſ. Pannon. Dwarf Mountain Pine.

Sedum minus flore luteo J. B. 694. The moſt ordinary yellow Prick-madam, or Stone-crop.

Siler montanum minus Boerh. 52. Small narrow-leaved Sermountain.

Vitis Idæa foliis oblongis albicantibus C. B. 470. Bilberry with long hoary Leaves.

Gallium ſaxatile ſupinum, molliore folio A. R. P. 1714. Supine Rock-Ladies Bedſtraw, with a ſofter Leaf.

VII.

A Catalogue of Plants preſented to the R. S. *by the Comp. of Apothecaries of* London, *purſuant to the Direction of Sir* Hans Sloane, *Bart. by Mr* Iſaac Rand, *Apothecary, F. R. S.*

N° 436. *p.* 1. Ann. 1733. 551. *Abrotanum mas, anguſtifolium, majus C. B.* 136. Common Sothern-wood.

— — — — — — 552. *Abrotanum mas, anguſtifolium, ſegmentis foliorum tenuiſſimis.* Sothern-wood with very fine Segments.

N° 440. *p.* 173. — 1734. 601. *Abſinthium inſipidum, Abſinthio vulgari ſimile C. B.* 139. Wormwood without Scent.

— — — — — — 602. *Abſinthium maritimum album* Ger. emac. 940. *Abſinthium Romanum* Offic. Lond. *ramulis expanſis. Engliſh* Sea Wormwood.

— — — — — — 603. *Abſinthium maritimum, ramulis & capitulis erectis.* Sea Wormwood with upright Branches and Heads.

— — — — — — 604. *Abſinthium maritimum, fruticoſius: ramulis erectis; tenuiſſime diviſis foliis.* Shrubby Sea Wormwood, with upright Branches, and finely divided Leaves.

N° 445. *p.* 1. — — 1735. 651. *Abutilon Althæodes; flore carneo, fructu globoſo. Hort. Elt. T.* 1. Yellow

Mallow reſembling Marſh-Mallow, with a Fleſh-coloured Flower, and a globoſe Fruit.

N° 447. *p.* 143. Ann. 1736. 701. *Abutilon, Lavateræ flore, fructu criſtato. Hort. Elt.* 3. Yellow Mallow, with a *Lavatera* Flower, and a creſted Fruit.

N° 471. *p.* 620. — 1740. 901. *Acanthus ſativus, vel mollis Virgilii C. B.* 383. Brank-urſine, or Bear's-Breech.

— — — — — 902. *Acanthus aculeatus C. B.* 383. Prickly Brank-urſine.

— — — — — 903. *Acanthus ſpinis mitioribus Pluk. Almageſt.* 6. Brank-urſine with milder Prickles.

N° 457. *p.* 406. — 1739. 851. *Acarna major, caule folioſo C. B.* 379. The greater Fiſh-thiſtle with winged Stalks.

N° 452. *p.* 1. — 1737. 751. *Acetoſa Ægyptia, roſeo ſeminis involucro, folio lacero*, Lippi. *D. Shaw Phyt. Afr. Spec.* N° 5. *Egyptian* Sorrel, with a Roſe-coloured Covering to the Seed, and a jagged Leaf.

— — — — — 752. *Adianthum nigrum, radice prælonga, arbores annoſas perreptante.* Griſ. Virid. Luſitan. *Filicula Luſitanica, Polypodii radice T. Inſt.* 541. Black Maiden-Hair of *Portugal*, with a Polypody Root.

— — — — — 753. *Admirabilis Peruviana, flore rubro Cluſ. rar. Plant. Hiſt. Lib. V. p.* 89. *Sloane Cat.* Jam. 91. Marvel of *Peru*, with a red Flower.

N° 456. *p.* 291. — 1738. 801. *Adonis Hellebori radice, Buphthalmi flore H. L. Bat.* Fennel-leaved black Hellebore.

N° 431. *p.* 199. — 1732. 501. *Alkekengi Americanum, foliis ſinuatis hirſutum. a D. Houſton.* Hairy *American* Winter Cherry, with ſinuated Leaves.

N° 447. *p.* 143. — 1736. 702. *Alyſſon Alpinum hirſutum luteum* T. Inſt. 217. *Leucoium luteum aizoides montanum. Column.* 2. 62. Yellow Alpine *Alyſſon*, with hairy Leaves.

— — — — — 703. *Amygdalus ſativa C. B.* 441. The Almond-Tree.

N° 452. *p.* 1. Ann. 1737. 754. *Androſæmum maximum fruteſcens* C. B. 280. Tutſan, *or* Park-Leaves.

N° 456. *p.* 291. — 1738. 802. *Anonis Alopecuroides, mitis, annua, purpuraſcens H. Elt.* 28. Purple, annual, mild, Fox-tail Reſt-harrow.

N° 445. *p.* 1. — 1735. 652. *Anonis Americana ſupina, Medicaginis facie; ſiliquis latis, planis.* Supine, *American* Reſt-harrow, like Moon-trefoil, with broad, plain Pods.

N° 447. *p.* 103. — 1736. 704. *Anonis Caroliniana, ramoſiſſima, erecta; floribus albis, laxe ſpicatis; ſiliquis inflatis.* Upright, branched Reſt-harrow of *Carolina*, with looſe Spikes of Flowers, and inflated Pods.

N° 436. *p.* 1. — 1733. 553. *Anonis flore minimo; ſiliquis craſſis, in foliorum alis ſeſſilibus. Ononis lutea, ſylveſtris, minima Colum. Ecph.* 104. Small yellow Reſt-harrow.

N° 471. *p.* 620. — 1740. 905. *Anthora* Off. Aconitum ſalutiferum, *ſive Anthora C. B.* Salutary Wolfs-Bane.

N° 431. *p.* 199. — 1732. 502. *Antirrhinum anguſti folium, majus, peregrinum, ruberrimo flore H. Reg. Par.* Large, narrow-leaved Snap-dragon, with red, deep Flowers.

N° 471. *p.* 610. — 1740. 904. *Antirrhinum anguſto folio, Linariæ eleganter variegato, flore rubro, rictu luteo Boerh.* Striped Snap-dragon.

N° 431. *p.* 199. — 1732. 503. *Antirrhinum arvenſe, majus, Italicum, majore flore, ex albo purpuraſcente.* Great *Italian*, Field Snap-dragon, with a purpliſh white Flower.

— — — — — — 504. *Aparines folio anomala; vaſculo ſeminali rotundo, multa ſemina minutiſſima continente* Sloane Cat. Jam. *p.* 50. Hiſt. Tab. 7. f. 4.

N° 471. *p.* 620. — 1740. 906. *Aphaca* Park. *Lathyrus luteus, annuus, foliis Convolvuli min. Mor.* Yellow Vetchling.

N° 440. *p.* 173. — 1734. 605. *Apium dulce, radice rapacea D. Juſſieu.* Sweet Parſley, with a Turnep Root.

— — — — — — 606. *Apium Macedonicum* C. B. 154. *Petroſelinum Macedonium Officin. Macedonian* Parſley.

N° 440. *p.* 173. Ann. 1734. 607. *Apium Pyrenaicum Thapſiæ facie T. Inſt.* 305. *Pyrenean* Parſley, with the Face of Deadly-carrot.

— — — — — — 608. *Apium Thapſiæ facie, majus & elatius. Apium petræum, ſive montanum album* J. B. *Pariſienſium.* Greater Parſley, with the Face of Deadly-carrot.

— — — — — — 609. *Apium Thapſiæ facie, medium.* Middle Parſley, with the Face of Deadly-carrot.

N° 431. *p.* 199. — 1732. 505. *Apocynum Americanum, Euonymi folio, flore ex albo virente. a D. Houſton. American* Dogs-Bane, with a Spindle-Tree Leaf, and a greeniſh white Flower.

N° 452. *p.* 1. — 1737. 755. *Aralia Canadenſis* T. Inſt. 300. *Panaces κάρπιμον ſive racemoſa, Canadenſis Cornut.* 74. *Canada* Berry-bearing Angelica.

N° 445. *p.* 1. — 1735. 653. *Ariſtolochia rotunda, flore ex purpura-nigro C. B.* Round Birthwort.

N° 440. *p.* 174. — 1734. 610. *Aſclepias alba flore C. B.* Pin. 303. *Aſclepias, ſive Vincetoxicum multis, floribus albicantibus* J. B. 2. 138. *Vincetoxicum Dod. Pempt.* 407. Swallow-wort.

— — — — — — 611. *Aſclepias anguſtifolia, flore flaveſcente H. R. Par.* Narrow-leaved Swallow-wort, with yellow Flowers.

— — — — — — 614. *After Americanus, latiſſimo, aurito, & ſerrato folio, floribus albidis, umbellatim diſpoſitis.* An *After Canadenſis, foliis imis amplioribus cordatis & ſerratis* D. Sarrazin. *Ac. Reg. Par.* 1720? *American* Starwort, with a very broad, eared, and ſerrated Leaf, and white Flowers, diſpoſed in Umbels.

— — — — — — 615. *After Americanus, præcox, anguſtifolius, parvo albente flore.* Narrow-leaved, early, *American* Starwort, with a ſmall, whitiſh Flower.

— — — — — — 613. *After annuus, foliis variis, flore amplo, peramæne purpureo. Kiangſita Sinenſis* D. Juſſieu. *After Chenopodii*

podii folio, annuus, flore ingenti ſpecioſus. Annual Starwort with various Leaves, and a fine purple Flower.

N° 440. *p.* 174. Ann. 1734. 616. *Aſter Novæ Angliæ, Linariæ foliis, Chamæmeli floribus Par. Bat.* 96. *New-England* Starwort, with Toad-flax Leaves.

— — — — — — 612. *Aſter ramoſus, annuus, Canadenſis Tourn. Inſt.* 482. Branched, annual Starwort of *Canada.*

— — — — — — 617. *Aſter Virginianus, latifolius, præcocior, purpuraſcente parvo flore* Park. Theat. *Aſteriſcus latifolius autumnalis Cornut.* 64. The earlier broad-leaved purpliſh *Virginian* Starwort.

N° 431. *p.* 199. — 1732. 506. *Aſteriſcus annuus, Luſitanicus, odoratus Boerh. Ind. Alt.* 105. *Portugal* ſweet-ſmelling, annual *Aſteriſcus.*

N° 456. *p.* 291. — 1738. 803. *Aſteriſcus Coronæ Solis flore & facie* H. Elt. 42. *Aſteriſcus* with the Flower and Face of Sun-flower.

N° 431. *p.* 199. — 1732. 507. *Aſtragalus humilis, Ornithopodii foliis, villoſis, ſiliquis propendentibus, brevibus, in ſpicam congeſtis.* Low Liquorice-vetch, with hairy Leaves of Birds-foot-trefoil, and ſhort, hanging Pods, gathered into a Spike.

N° 457. *p.* 406. — 1739. 852. *Aſtragalus, perennis, hirſutus, Alopecuroides, Galegæ foliis, floribus luteis.* Hairy, perennial, Fox-tail Liquorice-vetch, with Goat's Rue Leaves, and yellow Flowers.

N° 452. *p.* 1. — 1737. 756. *Aſtrantia major, corona floris candida T. Inſt.* 314. Black Maſterwort, with a white Flower.

— — — — — — 757. *Aſtrantia major, corona floris purpuraſcente T. Inſt.* 314. Black Maſterwort with a purpliſh Flower.

N° 445. *p.* 1. — 1735. 654. *Atriplex Halimoides, latifolia, dentata.* Broad-leaved indented Orrach.

N° 457. *p.* 406. — 1739. 853. *Bauhinia non aculeata, folio ſubrotundo, bicorni, floribus albis D.* Houſton. *Bauhinia* without Prickles, with a roundiſh, two-horned Leaf, and white Flowers.

N° 431.

N° 431. *p.* 1. Ann. 1732. 508. *Betonica Calpenſis, longiore folio.* An *Betonica rubicundiſſimo flore, Montis aurei H. R. Par?* Long-leaved Betony.

— — — — — — 509. *Betonica major Danica Park. Theat.* 615. Great Betony of *Denmark.*

N° 452. *p.* 1. — 1737. 758. *Betonica Orientalis, folio anguſtiſſimo & longiſſimo, ſpica florum craſſiori. T. Cor.* 13. Oriental Betony, with a very narrow, long Leaf, and a thick Spike.

N° 431. *p.* 199. — 1732. 510. *Betonica purpurea C. B.* 231. Wood Betony.

N° 457. *p.* 406. — 1739. 854. *Bidens Americana, flore albo radiato; foliis inferioribus trilobatis, ſuperioribus ſubrotundis, acute crenatis.* *American Bidens*, with a white, radiated Flower, and various Leaves.

N° 431. *p.* 199. — 1732. 511. *Bidens Americana, graminifolia & ramoſiſſima. Hieracium fruticoſum, anguſtiſſimis, gramineis foliis, capitulis parvis. Sloane Hiſt. Vol. I.* 255. *Tab.* 249. *f.* 3. Branched, Graſs-leaved, *American Bidens.*

— — — — — — 512. *Bidens Americana, trifolia & quinquefolia; flore albo, amplo, radiato.* An *Bidens trifolia, Americana, Leucanthemi flore. T. Inſt.* 462? Trifoliated, and quinquefoliated *American Bidens*, with a large, white, radiated Flower.

N° 447. *p.* 143. — 1736. 705. *Bidens Americana, triphylla; flore barbulis latis, albis radiato.* Trifoliated *American Bidens*, with a Ray of broad, white Semiflorets.

— — — — — — 706. *Bidens Americana, triphylla; flore luteo, capite folioſo.* An *Bidens Canadenſis latifolia, flore luteo T. Inſt.* 461? Trifoliated *American Bidens*, with a yellow Flower, and a leafy Head.

N° 452. *p.* 2. — 1737. 759. *Bidens Americana, triphylla, foliis anguſtis, acutis. Chryſanthemum Virginianum, folio acutiore, lævi, trifoliato; ſeu Anagyridis folio. H. Ox.* 111. *p.* 21. Trifoliated *American Bidens,*

Bidens, with narrow, ſharp-pointed Leaves.

N° 457. *p.* 406. Ann. 1739. 855. *Bidens latifolia, hirſutior, ſemine anguſtiore, radiato H. Elt. p.* 51. Broad-leaved, hairy *Bidens*, with a narrow, radiated Seed.

— — — — — — 856. *Bidens ſcabra, flore niveo, folio Panduræformi H. Elt. p.* 54. White flowered, rough *Bidens*.

— — — — — — 857. *Bignonia Americana, Fraxini folio, flore amplo phœniceo. T.* 164. Scarlet Trumpet-Flower.

— — — — — — 858. *Bignonia Americana, Fraxini folio, minor; flore coccineo.* Small Scarlet Trumpet-Flower.

N° 471. *p.* 620. — 1740. 907. *Braſſica campeſtris, perfoliata, alba C. B.* Codded Thorow-wax.

N° 436. *p.* 1. — 1733. 551. *Buphthalmum Creticum, Cotulæ facie, flore albo Breyn. Cent.* 1. *f.* 75. Camomile-like Ox-Eye.

N° 447. *p.* 143. — 1736. 707. *Bupleurum arboreſcens, Salicis folio* T. Inſt. 310. *Seſeli Æthiopicum frutex Dod.* 312. Shrub Hartwort of *Ethiopia*.

— — — — — — 708. *Calamintha, Pulegii odore, ſive Nepeta* C. B. 228. *Calamintha Officin. Lond.* Field Calamint.

— — — — — — 709. *Calamintha vulgaris, vel Officinarum Germaniæ C. B.* 228. Common Calamint.

— — — — — — 710. *Calcitrapoides procumbens, Cichorii folio, flore purpuraſcente. D. D' Iſnard. Mem. Ac. Reg. Anno* 1719. Procumbent *Calcitrapoïdes*, with a Succory Leaf, and a purpliſh Flower.

N° 457. *p.* 407. — 1739. 859. *Calendula minor arvenſis H. L. Bat.* Small Field Marigold.

— — — — — — 863. *Camara Americana, foliis parvis, ſubrotundis; floribus foliolis interceptis. Camara* with ſmall, roundiſh Leaves; and little Leaves between the Flowers.

— — — — — — 864. *Camara Americana, Salviæ foliis, mucronatis; floribus luteis. Camara* with pointed, Sage Leaves, and yellow Flowers.

N° 457. *p.* 407. Ann. 1739. 861. *Camara Americana, Urticæ folio, floribus miniatis.* Nettle-leaved *Camara*, with ſcarlet Flowers.

— — — — — — 860. *Camara Americana, Urticæ foliis latioribus, ſpinoſa, floribus miniatis.* Prickly Nettle-leaved *Camara*, with broader Leaves, and a ſcarlet Flower.

— — — — — — 862. *Camara Americana, Urticæ foliis minoribus, flore vario.* Nettle-leaved *Camara*, with a various Flower.

N° 447. *p.* 144. — 1736. 711. *Campanula Canarienſis, Atriplicis folio, tuberoſa radice.* T. Inſt. 109. *Canary* Bell-Flower, with Orach Leaves, and a tuberoſe Root.

N° 452. *p.* 2. — 1737. 760. *Campanula pentagonia, perfoliata, Moriſ. H. Ox.* 11. 457. Perfoliated Bell-Flower.

N° 447. *p.* 144. — 1736. 712. *Campanula pratenſis, flore conglomerato C. B.* 94. Little Throatwort, *or Canterbury* Bells.

N° 445. *p.* 1. — 1735. 655. *Canella alba, cujus cortex eſt* Cortex Winteranus *Officin. Lond. Arbor baccifera, laurifolia, aromatica, fructu viridi, calyculato, racemoſo Sloan Hiſt. Jam. T.* 191. *f.* 2. Winter's Bark, *or* wild Cinnamon-Tree.

— — — — — — 656. *Cannabina Cretica fructifera T. Cor.* 52. Fruit-bearing *Cannabina* of Candy.

N° 471. *p.* 620. — 1740. 908. *Cannabis ſativa alba Off.* Hemp.

N° 457. *p.* 407. — 1739. 865. *Caprifolium Germanicum Dod. Dutch* Honey-Suckle.

N° 431. *p.* 200. — 1732. 513. *Cardamine annua, glabra, parvo flore, foliis vix ſinuatis.* Smooth, annual Ladies-Smock, with a ſmall Flower, and Leaves hardly ſinuated.

— — — — — — 514. *Cardamine Sicula, foliis fumariæ T. Inſt.* 224. *Sicilian* Ladies-Smock, with Fumitory Leaves.

N° 456. *p.* 291. — 1738. 804. *Carduus galactites J. B.* 111. 54. *J. Bauhinus*'s Milk-Thiſtle.

N° 447. *p.* 144. — 1736. 713. *Carduus humilis alatus, ſive Carduus Mariæ annuus; folio lituris obſcuris notato H. C. Boerh. Ind. alt.* 136. Annual Milk-Thiſtle, with obſcure Streaks.

N° 456.

N° 456. *p.* 291. Ann. 1738. 805. *Caryophyllata Alpina lutea C. B.* 322. Yellow Alpine Avens.

N° 431. *p.* 200. — 1732. 515. *Caſſia herbacea, Pſeudoacaciæ foliis a D. Collinſon. Caſſia Marilandica; pinnis foliorum oblongis, calyce floris reflexo* Martyn. *Hiſt. Plant. rar. Dec.* III. N° 1. Caſſia of *Maryland*, with oblong Lobes, and a reflexed Empalement.

N° 471. *p.* 620. — 1740. 911. *Caſſida Alpina ſupina magno flore T. Cor.* Supine, Mountain Skull-Cap, with a large Flower.

N° 452. *p.* 2. —— 1737. 761. *Caſſine vera perquam ſimilis, Arbuſcula Phillyreæ foliis antagoniſtis. Ex Provincia Carolinienſi.* Pluk. *Mantiſſ. p.* 40. *Phytogr. Tab.* 381. *Fig.* 3. The Caſſioberry Buſh.

N° 471. *p.* 620. — 1740. 909. *Centaurium majus foliis in plures lacinias diviſis C. B. Off.* Great Centory.

N° 452. *p.* 2. —— 1737. 763. *Cepa Aſcalonia Matthiol.* 556. Eſchalottes.

— —— — — —— 762. *Cepa fiſſilis Matthiol.* 555. Ciboule.

N° 456. *p.* 291. — 1738. 806. *Chamælæa tricoccos C. B.* 462. Widow-Wail.

N° 431. *p.* 200. — 1732. 516. *Chamæmelum trimeſtre, nudum, capitulis minimis.* Naked Camomile, with very ſmall Heads.

N° 457. *p.* 407. — 1739. 866. *Chenopodio-morus media, foliis argute dentatis.* Middle Mulberry-Blite, with ſharp-pointed Leaves.

N° 456. *p.* 291. — 1738. 807. *Chenopodium Ambroſioides, folio ſinuato T.* 506. Oak of *Jeruſalem.*

— —— — —— —— 808. *Chenopodium Ambroſioides Mexicanum T.* 506. *Mexican* Oak of *Jeruſalem.*

N° 452. *p.* 2. —— 1737. 764. *Chenopodium Ambroſioides Mexicanum fruticoſum.* Shrubby *Mexican* Oak of *Jeruſalem.*

N° 457. *p.* 407. — 1739. 867. *Chenopodium Botryos folio, ſubtus candicante. Atriplex ſylveſtris* 11. *Tab. Icon.* 407. Gooſe-Foot, with an Oak of *Jeruſalem* Leaf, hoary underneath.

N° 457. *p.* 407. Ann. 1739. 868. *Chenopodium folio laciniato, majus. Pes Anſerinus Fuchſii.* Great Gooſe-Foot, with a jagged Leaf.

— — — — — — 869. *Chenopodium folio ſinuato, candicante* T. 506. *Atriplex ſylveſtris* Tab. *Icon.* 406. Common wild Orache.

— — — — — — 870. *Chondrilla Sonchi folio, flore luteo palleſcente T.* 475. Ivy-leaved Lettuce.

N° 452. *p.* 2. — 1737. 765. *Chriſtophoriana Americana procerior, & longius ſpicata Dillen. H. Elt. Tab.* 67. Tall *American* Herb *Chriſtopher*, with long Spikes.

N° 431. *p.* 200. — 1732. 517. *Chryſanthemoides oſteoſpermon, Africanum, arboreum, foliis Populi albæ Boerh. Ind. alt.* 104. *African* hard-ſeeded *Tree Chryſanthemum*, with Leaves like the white Poplar.

N° 436. *p.* 1. — 1733. 555. *Cicer ſativum C. B.* 347. Chiches, *or* Chich-Peaſe.

N° 457. *p.* 407. — 1739. 871. *Cirſium arvenſe, repens, folio vix ſinuato, in aculeum abeunte.* Creeping Field gentle Thiſtle, with a Leaf ſcarce ſinuated, ending in a Prickle.

N° 447. *p.* 144. — 1736. 715. *Ciſtus ladanifera, Cretica, flore purpureo T. Cor.* 19. Large ſweet *Ciſtus, or* Rock-Roſe from *Crete.*

N° 456. *p.* 291. — 1738. 809. *Clinopodium Americanum, Salicariæ foliis, perforatis, Pulegii odore. American* Field Baſil, with Willow-wort, perforated Leaves, and a Smell of Penny-Royal.

— — — — — — 810. *Clinopodium Menthæ folio, incanum & odoratum H. Elt. Tab.* 74. Hoary, ſweet-ſmelling Field-Baſil, with a Mint Leaf.

N° 471. *p.* 620. — 1740. 910. *Clinopodium Orientale, hirſutum, foliis inferioribus Ocimum, ſuperioribus Hiſſopum referentibus T. Cor.* Hairy oriental Field-Baſil, with the under Leaves like Baſil, and the upper like Hyſſop.

N° 447. *p.* 144. — 1736. 714. *Clinopodium Virginianum, anguſtifolium; floribus amplis, luteis, purpuro*

puro maculatis, &c. Pluk. *Phyt. Tab.* 24. *Fig.* 1. Narrow-leaved Field-Baſil of *Virginia*, with large yellow Flowers, ſpotted with Purple.

N° 440. *p.* 174. Ann. 1734. 618. *Cnicus cæruleus, humilis, Montis Lupi H. L. Bat.* Low blue Diſtaff-Thiſtle.

N° 431. *p.* 200. — 1732. 518. *Cnicus Creticus, Atractylidis folio & facie, flore candidiſſimo T. Cor.* Candy, white-flowered Diſtaff-Thiſtle.

N° 456. *p.* 291. — 1738. 811. *Cnicus Hiſpanicus, arboreus fœtidiſſimus. T.* 451. Stinking, *Spaniſh*, Tree Diſtaff-Thiſtle.

N° 471. *p.* 620. — 1740. 913. *Cochlearia minor rotundifolia noſtras Raii Syn.* The leſſer round-leaved Scurvy-Graſs.

— — — — — — 912. *Colutea veſicaria C. B.* Baſtard Sena.

N° 452. *p.* 2. —— 1737. 766. *Commelina anguſtifolia procumbens.* Procumbent, narrow-leaved Commeline.

N° 436. *p.* 1. —— 1733. 556. *Convolvulus Americanus, minor; Polygoni ſubhirſuto folio; flore parvo, ceruleo, patente.* Small *American* Bindweed, with a hairy Knot-graſs Leaf, and a ſmall open Flower.

The *Viſtnu Clandi* Hort. Malab. 11. *p.* 131. *Tab.* 164. comes near it.

N° 436. *p.* 1. —— 1733. 557. *Convolvulus major, rectus, Creticus, argenteus Mor. Hiſt.* 2. *p.* 11. Silver, upright, great Bindweed of Candy.

— — — — — — 558. *Convolvulus ramoſus, incanus, foliis Piloſellæ C. B.* 294. Hoary, branched Bindweed, with Mouſe-Ear Leaves.

N° 431. *p.* 200. — 1732. 519. *Corchoro affinis, Chamædryos folio; flore ſtamineo; ſeminibus atris, quadrangulis, duplici ſerie diſpoſitis* Sloane *Cat. Jam. p.* 50. *Hiſt. Tab.* 94. *f.* 1.

N° 447. *p.* 144. — 1736. 716. *Cotyledon Afra; folio craſſo, lato, laciniato; floſculo aureo. Boerh. Ind. alt.* 288. *African* Navel-wort, with

a thick, broad, jagged Leaf, and a golden Flower.

N° 456. *p.* 292. Ann. 1738. 814. *Crocus albus, variegatus; fundo floris flaveſcente.* White, variegated *Crocus*, with a yellowiſh Bottom to the Flower.

— — *p.* 291. — — 812. *Crocus vernus, latifolius, flavus C. B.* Yellow, broad-leaved Spring *Crocus*.

— — *p.* 292. — — 813. *Crocus vernus, latifolius; flore albo, purpuro-violacea baſi C. B.* 66. Broad-leaved Spring *Crocus*, with a white Flower, and a violet purple Baſe.

N° 471. *p.* 621. — 1740. 914. *Crotolaria Americana, fruteſcens, flore luteo, ramulis alatis, folio mucronato Ind. Hort. Chel.* Shrubby *American* Crotolaria, with a yellow Flower, winged Branches, and a pointed Leaf.

N° 457. *p.* 407. — 1739. 872. *Cruciata nova, Romana, minima, muralis Col. Ecph.* 295. Small, *Roman*, Wall Croſs-wort.

N° 447. *p.* 144. — 1736. 717. *Cupreſſus Virginiana* Tradeſcanti Catal. 106. *Cupreſſus Virginiana, foliis Acaciæ deciduis H. L. B.* 107. *Virginian* Cypreſs.

N° 457. *p.* 407. — 1739. 873. *Cynogloſſum Virginianum, flore minimo, albo Baniſteri Pluk. Alm.* 126. *Virginian* Hounds-Tongue, with a very ſmall, white Flower.

N° 452. *p.* 2. — 1737. 767. *Dalea* D^ni Millar, *inventoris.*

N° 456. *p.* 292. — 1738. 815. *Delphinium Platani folio, Staphyzagria dictum T.* 428. Louſe-wort.

N° 471. *p.* 621. — 1740. 917. *Delphinium ſive conſolida regalis, flore roſeo. Tourn.* Roſe-coloured Lark-Spur.

N° 452. *p.* 2. — 1737. 768. *Dentaria bulbifera Lob. Icon.* 687. Bulbiferous Tooth-wort.

N° 445. *p.* 1. — 1735. 657. *Digitalis Acanthoides, Canarienſis, fruteſcens; flore aureo Hort. Amſt.* 11. *p.* 105. Shrubby *Canarian* Fox-glove, with a golden Flower.

N° 452. *p.* 2. — 1737. 769. *Digitalis minima, Gratiola dicta* H. Ox. Part. 11. 479. *Gratiola Centauroides*

tauroides C. B. 279. Hedge-Hyſſop, *or* Water-Hyſſop.

N° 447. *p.* 144. Ann. 1736. 718. *Doria Ægyptia, annua; foliis trilobatis, ſerratis.* Annual *Egyptian Doria*, with ſerrated, trilobated Leaves.

— — — — — — 719. *Doria parva, annua; foliis anguſtis, leviter ſerratis.* Small, annual *Doria*, with narrow, lightly ſerrated Leaves.

N° 431. *p.* 200. — 1732. 520. *Doria, quæ Jacobæa Africana, fruteſcens; Lavendulæ folio, latiori H. Amſt.* 2. 141. Shrubby *Doria*, with a broad Lavender Leaf.

N° 456. *p.* 292. — 1738. 816. *Doronicum Plantaginis folio C. B.* 184. Plantain-leaved Leopards Bane.

N° 471. *p.* 621. — 1740. 916. *Doronicum Romanum Off.* Common, *or* broad-leaved Leopards Bane.

— — — — — — 915. *Dracocephalon Americanum Breyn. Prod.* *American* Dragons-Head.

N° 447. *p.* 144. — 1736. 730. *Echinopus Græcus, tenuiſſime diviſus, & lanuginoſus, capite minori cæruleo. T. Cor.* 34. Woolly Globe-Thiſtle, with finely divided Leaves, and a ſmall blue Head.

N° 436. *p.* 1. — 1733. 559. *Elæagnus Orientalis, anguſtifolius; fructu parvo, Olivæformi, ſubdulci* T. Cor. 53. *Ziziphus alba Cluſ. Hiſt.* 29. The white Jujube-Tree.

N° 452. *p.* 2. — 1737. 770. *Elichryſum anguſtiſſimo folio* T. Inſt. 452. *Stæchas citrina tenuifolia, altera, ſive Italica J. B.* 111. 155. The narroweſt-leaved eternal Flower.

N° 471. *p.* 621. — 1740. 918. *Ephemerum Virginianum* Tradeſcanti *flore purpureo Park. Parad.* Tradeſcant's *Virginian* Spider-wort, with a purple Flower.

N° 452. *p.* 2. — 1737. 772. *Eruca ſylveſtris* Ger. *Eruca ſylveſtris, tenuifolia, perennis, flore luteo J. B.* 11. 861. Fine-leaved, perennial Rocket, with a yellow Flower.

— — — — — — 773. *Eruca Bellidis folio Mor. H. Ox. P.* 11. 231. Daiſy-leaved Rocket.

N° 440.

N° 440. *p.* 174. Ann. 1734. 619. *Eruca Tanaceti folio H. R. Par.* Tanſey-leaved Rocket.

N° 456. *p.* 292. — 1738. 817. *Eryngium cæruleum, albis maculis notatum H. Ox.* 111. 165. Blue Eringo, marked with white Spots.

N° 457. *p.* 407. — 1739. 874. *Eryngium maritimum C. B.* 386. Sea-Holly, *or* Eringo.

N° 456. *p.* 292. — 1738. 818. *Eryngium montanum, Amethyſtinum C. B.* 386. Amethyſt Eringo.

N° 457. *p.* 408. — 1739. 875. *Eryngium vulgare* C. B. 386. *Eryngium campeſtre Dod.* 730. Common Eringo.

N° 431. *p.* 200. — 1732. 521. *Eupatoriophalacron Americanum; Hyperici foliis; ſemine adunco.* a D. *Houſton. American Eupatoriophalacron*, with *St.-John*'s Wort-leaves, and a hooked Seed.

N° 471. *p.* 621. — 1740. 919. *Eupatorium Americanum, herbaceum, Meliſſæ folio, villoſum Houſt.* Herbaceous, *American* Hemp-Agrimony, with a Baum Leaf, and hairy.

N° 452. *p.* 2. —— 1737. 774. *Eupatorium cannabinum* C. B. 320. *Eupatorium Avicennæ Officin.* Common Hemp-Agrimony, *or Dutch* Agrimony.

— — *p.* 3. — — — 775. *Eupatorium folio oblongo, rugoſo; caule purpuraſcente T. Inſt.* 456. *Canada* Hemp-Agrimony, with a long, rough Leaf, and purpliſh Stalk.

N° 445. *p.* 1. —— 1735. 658. *Eupatorium Virginianum; Salviæ foliis longiſſimis, acuminatis, perfoliatum Pluk. Phyt. T.* 87. *Fig.* 6. Perfoliated, *Virginian* Hemp-Agrimony, with very long and pointed Sage-Leaves.

N° 440. *p.* 174. — 1734. 620. *Fagopyrum Americanum, anguſtifolium, procumbens; caulibus lappaceis.* Procumbent narrow-leaved *American* Buck-Wheat, with prickly Stalks.

N° 452. *p.* 3. —— 1737. 776. *Fagopyrum erectum; ſeminibus ad angulos dentatis, ſpicatim naſcentibus.* Ex *Ruſſia.* Upright *Ruſſian* Buck-Wheat, with Seeds indented at the Angles, and growing in Spikes.

N° 440.

N° 440. *p.* 174. Ann. 1734. 621. *Fagopyrum vulgare ſcandens. T. Inſt.* 511. Black Bindweed.

N° 471. *p.* 621. — 1740. 920. *Ferula major, ſeu fœmina Plinii Mor. Umb.* Fennel-Giant.

N° 445. *p.* 1. — 1735. 659. *Ficoides, folio parvo, enſiformi; purpureis floribus, ad caulium extremitates fere umbellatim naſcentibus.* An *Meſembryanthemum falcatum, minimum, &c. Hort. Elth.* 288. Fig-Marygold, with a ſmall Sword-faſhioned Leaf, and purple Flowers, growing in a Sort of Umbells at the Extremities of the Stalks.

N° 452. *p.* 3. — 1737. 777. *Ficus Orientalis, foliis in lacinias anguſtas profunde inciſis.* The large white *Turkey* Fig.

N° 447. *p.* 144. — 1736. 721. *Filicula, quæ Adiantum nigrum* Officinarum. *Adiantum foliis longioribus, pulverulentis; pediculo nigro C. B.* 355. Common black Maiden-Hair, *or* Oak-Fern.

— — *p.* 145. — — 722. *Filix ſaxatilis, foliis tenuioribus & acutioribus. Adiantum nigrum, pinnulis Cicutariæ diviſura* D. Bobart. *Raii Syn.* 11. 50. Black Maiden-Hair, with finely divided Leaves.

— — — — — — 723. *Filix ſaxatilis, caule tenui fragili* Raii *Syn. Ed.* 11. 50. Pluk. *Phyt.* 180. *f.* 5. Stone-Fern, with a thin, brittle Leaf.

N° 471. *p.* 621. — 1740. 921. *Fraxinella flore albo, ſive Dictamnus albus Off.* White Dittany, *or* Fraxinella.

N° 436. *p.* 1. — 1733. 560. *Fraxinus florifera, botryoides Mor. H. Reg. Bleſ.* Flowering Aſh.

N° 431. *p.* 200. — 1732. 522. *Frutex Virginianus, trifolius; Ulmi ſamaris* D. Baniſter. *Pluk. Almag.* 159.

— — — — — — 523. *Fumaria Africana, veſicaria, ſcandens* Par. Bat. App. *Cyſticapnos Africana, ſcandens* Boerh. Ind. 310. *African,* climbing, Bladder-Fumitory.

N° 452. *p.* 3. — 1737. 779. *Fumaria bulboſa, radice cava, major C. B.* 143. Great bulbous-rooted Fumitory, *or* Hollow-root.

N° 452.

N° 452. *p.* 3. Ann. 1737. 780. *Fumaria lutea C. B.* 143. Yellow Fumitory.

— — — — — — 778. *Fumaria officinarum & Dioscoridis C. B.* 143. Common Fumitory.

— — — — — — 781. *Fumaria sempervirens & florens, flore albo Boer. Ind.* 130. Ever-green Fumitory, with a white Flower.

N° 471. *p.* 621. — 1740. 922. *Fumaria siliquosa sempervirens Cornuti.* Ever-green *American* Fumitory.

N° 471. *p.* 621. — 1740. 923. *Galega quinquefolia, floribus parvis, rubris. Houston.* Five-leaved Goat's-Rue, with small, red Flowers.

N° 452. *p.* 3. — 1737. 782. *Galeopsis patula segetum, flore purpurascente* T. Inst. 185. *Sideritis arvensis rubra Park.* Narrow-leaved All-heal, *or* Iron-wort.

N° 447. *p.* 145. — 1736. 724. *Garidella foliis tenuissime divisis* T. Inst. 655. *Nigella Cretica, folio Fœniculi C. B.* 146. Fennel-Flower, with very finely divided Leaves.

N° 440. *p.* 174. — 1734. 622. *Genista tinctoria Ger. emac.* 1136. Greenweed, *or* Dyer's Weed, *or* Woodwaxen.

— — *p.* 175. — — 623. *Genista tinctoria maxima Austriaca D. Boerhaave.* The greatest *Austrian* Woodwaxen.

N° 445. *p.* 2. — 1735. 660. *Geranium Africanum, arborescens, flore dilute coccineo; Malvæ folio minore.* Arborescent Cranes-Bill of *Africa*, with a pale scarlet Flower, and a small mallow Leaf.

See *Hort. Elth.* Tab. 125. f. 152.

N° 471. *p.* 621. — 1740. 924. *Gingidium Rawolfii, foliis Fæniculi C. B.* Fennel-leaved Pick-tooth.

N° 445. *p.* 2. — 1735. 661. *Gramen Americanum; spica echinata; majoribus locustis Schol. Bot. American* Grass, with an echinated Spike, and greater Locusts.

— — — — — — 662. *Gramen arundinaceum, Halepense; Tragopogonis folio D. Bobart.* Reed-Grass of *Aleppo*, with a Goat's Beard Leaf.

— — — — — — 663. *Gramen miliaceum, Americanum, latifolium; panicula parva, laxa.* An *Gramen miliaceum Americanum, majus,*

jus, panicula minore Pluk. Alm. 176? Broad-leaved *American* Millet-graſs, with a ſmall, looſe Spike.

N° 445. *p.* 2. Ann. 1735. 664. *Gramen paniceum, ſpica ſimplici, lævi Raii Syn. Ed.* 11. *p.* 249. Panick-graſs, with a ſingle, ſmooth Ear.

— — — — — — 665. *Gramen paniceum, ſpica aſpera C. B.* 8. Rough-eared Panick-graſs.

— — — — — — 666. *Gramen paniceum, ſpica diviſa C. B.* 8. Panick-graſs, with a divided Spike.

— — — — — — 667. *Gramen paniceum Jamaicenſe, ſpica diviſa nitida. Jamaica* Panick-graſs, with a neat, divided Spike.

N° 440. *p.* 175. — 1734. 624. *Granadilla flore albo, fructu reticulato Boerh. Ind.* 82. White Paſſion-Flower, with a reticulated Fruit.

N° 436. *p.* 2. — 1733. 562. *Granadilla folio tricuſpidi, latiori; flore minimo.* An *Granadilla folio tricuſpidi; flore parvo, flaveſcente T. Inſt.* 240? Paſſion-Flower, with a three-pointed Leaf, and a very ſmall Flower.

— — — — — — 561. *Granadilla Hiſpanis Flos Paſſionis Italis Col. in Recch.* 889. Three-leaved Paſſion-Flower.

N° 440. *p.* 175. — 1734. 625. *Granadilla oblongo acuminato folio, flore purpureo.* An *Granadilla folio oblongo, ſerrato, flore purpureo D. Houſton?* Purple Paſſion-Flower, with an oblong, acuminated Leaf.

N° 471. *p.* 621. — 1740. 925. *Harmala* Off. *Ruta quæ dici ſolet Harmala J. B.* Wild Rue.

— — — — — — 927. *Hedyſarum clypeatum, flore ſuaviter rubente Hort. Eyſt. French* Honey-ſuckle, with a delicate red Flower.

N° 431. *p.* 200. — 1732. 524. *Hedyſarum triphyllum, Canadenſe Cornut.* 44. Three-leaved *Canada French* Honey-ſuckle.

N° 447. *p.* 145. — 1736. 725. *Heleniaſtrum Americanum, latifolium, ſerratum.* Broad-leaved, ſerrated, *American Heleni ſtrum.*

N° 445. *p.* 2. — 1735. 668. *Helleborus niger hortenſis, flore viridi C. B.* 185. Bears-Foot.

N° 471. *p.* 621. — 1740. 926. *Herba Paris Off.* Herb *Paris.*

N° 452. *p.* 3. Ann. 1737. 783. *Hernandia, amplo Hederæ folio, umbilicato* Plum. Nov. Gen. 6. *Nux veſicaria oleoſa, foliis umbilicatis, ex Inſula Barbadenſi Pluk. Phyt.* 208. *Fig.* 1. Jack in a Box.

N° 447. *p.* 145. — 1736. 626. *Hieracium Chondrillæ folio, hirſutum C. B.* 127. Rough-leaved, yellow Devil's Bit.

N° 471. *p.* 621. — 1740. 928. *Hieracium hortenſe, floribus atro-purpureis C. B.* Golden Mouſe-Ear, *or* Grim the Collier.

N° 431. *p.* 201. — 1732. 525. *Hieracium medio nigrum, Bæticum, minus. Park. Theat.* 792. Smaller *Spaniſh* Hawkweed, with yellow and black Flowers.

— — — — — — 526. *Hieracium medio nigrum, Bæticum, latifolium, amplo flore.* Broad-leaved *Spaniſh* Hawkweed, with a large yellow and black Flower.

N° 456. *p.* 292. — 1738. 819. *Hyoſcyamus albus major, vel tertius Dioſcoridis & quartus Plinii C. B.* 169. White Henbane.

— — — — — — 821. *Hyoſcyamus luteus, minor fruteſcens.* Small, ſhrubby, yellow Henbane.

— — — — — — 820. *Hyoſcyamus major, albo ſimilis, Umbilico floris atro-purpureo. T. Cor.* 1. Great Henbane, like the white, but with a dark purple Bottom to the Flower.

N° 452. *p.* 3. — 1737. 784. *Hypericum Androſæmum dictum J. B. Androſæmum alterum hirſutum. Colum.* Ec. 75. *Tutſan-St John's* Wort.

N° 436. *p.* 2. — 1733. 563. *Hyſſopus rubro flore C. B.* 217. Red flowered Hyſſop.

N° 431. *p.* 201. — 1732. 527. *Jacobæa Afra, folio Botryos Boerh. Ind. alt.* 99. *African* Ragwort, with an Oak of *Jeruſalem* Leaf.

N° 457. *p.* 408. — 1739. 877. *Jacobæa foliis ferulaceis.* Ragwort, with ferulaceous Leaves.

N° 471. *p.* 621. — 1740. 929. *Jacobæa maritima C. B.* Sea Ragwort.

N° 431. *p.* 201. — 1732. 528. *Jacobæa Pannonica prima* Cluſ. Hiſt. 21. *Senecio incanus, pinguis C. B.* 131. Cotton Groundſel, *or* ſtrong-ſcented Groundſel.

N° 436. *p.* 2. Ann. 1733. 564. *Jaſminum Azoricum, trifolium; flore albo odoratiſſimo H. Amſt.* 1. *p.* 159. Three-leaved Azorian Jaſmine, with very ſweet, white Flowers, *or* Ivy-leaved Jaſmine.

N° 456. *p.* 292. — 1738. 822. *Jaſminum humilius, magno flore C. B.* 398. *Spaniſh*, white, *or Catalonian* Jaſmine.

— — — — — — 823. *Iris tuberoſa, folio anguloſo C. B.* 40. Tube-roſe *Iris*, with an angular Leaf.

N° 431. *p.* 201. — 1732. 529. *Ketmia Afra, veſicaria; foliis profundius inciſis, vix crenatis Boer. Ind.* 272. *African* Bladder *Ketmia*, with deeply cut Leaves.

— — — — — — 530. *Ketmia veſicaria, Africana T. Inſt.* 101. *African* Bladder *Ketmia.*

— — — — — — 531. *Ketmia veſicaria vulgaris T. Inſt.* 101. Common Bladder *Ketmia.*

N° 436. *p.* 2. — 1733. 565. *Lachrymá Job. Cluſ. Hiſt.* ccxvi. *Job*'s Tears, *or* Reed-Millet.

N° 440. *p.* 175. — 1734. 626. *Lapathum Ægyptiacum, annuum, Pariotariæ folio, capſula ſeminis longius barbata H. Piſan.* Annual *Ægyptian* Dock, with a pellitory Leaf, and a long Beard to the Seed.

— — — — — — 627. *Lapathum aquaticum, folio cubitali C. B.* 116. Great Water Dock.

— — — — — — 628. *Lapathum hortenſe, rotundifolium, ſive montanum C. B.* 115. Baſtard Monk's Rhubarb, *or* great round-leaved Dock.

— — — — — — 629. *Lapathum rotundifolium, maximum, q.* Rhaponticum *Officin.* Rhapontick.

— — — — — — 630. *Lapathum ſativum* Dod. *q.* Patientia *Officin.* Monk's Rhubarb, *or* Garden Patience.

N° 457. *p.* 408. — 1739. 878. *Lappa major, ex omni parte minor; capitulis parvis, eleganter reticulatis* Pluk. *Alm.* Small Burdock, with reticulated Heads.

— — — — — — 877. *Lappa ſive Bardana major, flore albo H. Ox.* 111. 147. Great Burdock, with white Flowers.

N° 456. *p.* 292. — 1738. 824. *Laſerpitium anguſtifolium, majus, ſegmentis longioribus, & indiviſis* H.

Ox. III. 321. Great, narrow-leaved Laſerwort, with longer and undivided Leaves.

N° 456. *p.* 292. Ann. 1738. 825. *Laſerpitium foliis latioribus; ſemine criſpo & verrucoſo H. Ox.* III. 320. Laſerwort with broader Leaves, and a curled and warty Seed.

— — — — — 826. *Laſerpitium humilius, Paludapii folio, flore albo. T.* 325. Dwarf Laſerwort, with a Smallage Leaf, and a white Flower.

— — — — — 827. *Laſerpitium lobis anguſtioribus, & dilute virentibus, conjugatim poſitis H. Ox.* III. 321. Laſerwort with narrower, and pale-green Lobes, placed by Pairs.

— — — — — — 828. *Laſerpitium lobis anguſtioribus, longioribus & dilute virentibus, plurifariam diviſis* Pluk. *Phyt. Tab.* 198. *f.* 6. Laſerwort with narrow, long, pale-green Leaves, variouſly divided.

— — — — — — 829. *Laſerpitium, lobis minimis, trifidis, ſeminum alis fere planis.* An *Laſerpitium anguſtiore folio, umbella concava, & contracta.* Pluk. *Phyt. Tab.* 199. Laſerwort with very ſmall, trifid Lobes, and the Wings of the Seeds almoſt plain.

N° 471. *p.* 621. — 1740. 930. *Lathyrus perennis latifolius C. B.* Peaſe everlaſting.

— — — — — — 931. *Lathyrus ſylveſtris Dodonæi Park.* The other great wild *Lathyrus, or* everlaſting Peaſe.

— — — — — — 932. *Lathyrus ſiculus, flore odorato, magno* Boerh. Ind. 159. *Sicilian* everlaſting Pea, with a large, ſweet-ſmelling Flower.

N° 456. *p.* 293. — 1738. 830. *Lavandula anguſtifolia* C. B. 21. *Lavendula Officinarum.* Narrow-leaved *or* ſmall Lavender, *or* Lavender Spike.

— — — — — — 831. *Lavandula latifolia* C. B. 216. *Spica Nardus Germanica Trag.* The moſt common *or* broad-leaved Lavender.

N° 456. *p.* 293. Ann. 1738. 832. *Leonurus minor, Capitis Bonæ ſpei vulgo Boerh.* 180. Leſſer Lion's Tail from the *Cape of Good Hope*, with a Cat-mint Leaf.

N° 431. *p.* 201. — 1732. 532. *Lepidium humile, incanum arvenſe T. Inſt.* 816. *Arabis ſive Draba & Naſturtium Babylonicum Lob. Ic.* 224. Hoary, dwarf Dittander.

N° 457. *p.* 408. — 1739. 879. *Lilac Liguſtri folio T.* 602. Lilac with Privet Leaves, *falſly called* the *Perſian* Jaſmine.

N° 431. *p.* 201. — 1732. 533. *Limonium lignoſum, Gallis viduum Boccon. Rar.* 35. Wooddy Sea-Lavender.

N° 456. *p.* 293. — 1738. 833. *Limonium minimum, flagellis tortuoſis, noſtras.* The leaſt Sea-Lavender, with twiſted Branches.

— — — — — — 834. *Linaria annua, anguſtifolia; floſculis albis, longius caudatis Triumph.* Narrow-leaved, annual Toad-Flax, with white Flowers, and long Spurs.

N° 447. *p.* 145. — 1736. 727. *Linaria hederaceo folio, glabro; ſeu Cymbolaria vulgaris. T. Inſt.* 169. Round-leaved Toad-Flax.

— — — — — — 728. *Lingua Cervina minima; folio obtuſo, undulato & ſerrato.* An *Lingua Cervina, anguſtifolia, lucida; folio ſerrato H. Reg. Par.?* Small Harts-Tongue, with an obtuſe, undulated, and ſerrated Leaf.

— — — — — — 729. *Lingua Cervina maxima; undulato folio, auriculato per baſin H. Reg. Par.* Great Harts-Tongue, with an undulated Leaf, eared at the Baſe.

— — — — — — 730. *Lingua Cervina minor, criſpa uno pediculo trifolia H. Reg. Par. Pluk. Phyt.* 248. *f.* 2. Small, trifoliated Harts-Tongue.

— — — — — — 731. *Lingua Cervina Officinarum. C. B.* 353. Common Harts-Tongue.

N° 436. *p.* 2. — 1733. 566. *Lotus hæmorrhoidalis, humilior & candidior T. Inſt.* 403. Lower and whiter, hemorrhoidal Birds-Foot Trefoil.

N° 431.

N° 431. *p.* 201. Ann. 1732. 534. *Lotus Lybica Dalechampii Lug.* 509. Birds-Foot Trefoil of *Lybia.*

— — — — — — 535. *Lotus minor, glabra, foliis longioribus & anguſtioribus. Hort. Edin.* Small, ſmooth Birds-Foot Trefoil, with longer and narrower Leaves.

— — — — — — 536. *Lotus pratenſis, major, glabra* D. Vaillant. *Bot. Par.* Great, ſmooth, Meadow Birds-Foot Trefoil.

N° 437. *p.* 2. — 1733. 567. *Lychnidea Caroliniana; floribus quaſi umbellatim diſpoſitis; foliis lucidis, craſſis, acutis.* Martyn. *Hiſt. p.* 10. Lychnidea of *Carolina* with umbellated Flowers, and ſhining, thick, ſharp-pointed Leaves.

N° 471. *p.* 621. — 1740. 933. *Lychnis multiplex, flore purpureo C. B.* Double red Campion, *commonly called* Double red Bachelor's Button.

N° 452. *p.* 3. — 1737. 785. *Lycoperſicon Galeni Ang.* Apples of Love.

N° 457. *p.* 408. — 1739. 880. *Lyſimachia annua, minima, Polygoni folio T.* 142. Small, annual, Looſe-ſtrife, with a Knot-Graſs Leaf.

N° 431. *p.* 201. — 1732. 537. *Lyſimachia Canadenſis, lutea; folio Jalappæ D. Sarrazen.* Yellow Looſe-ſtrife of *Canada.*

N° 456. *p.* 293. — 1738. 835. *Matricaria vulgaris, ſeu ſativa, caulibus rubentibus H. L. Bat.* Common Feverfew, with reddiſh Stalks.

N° 436. *p.* 2. — 1733. 568. *Marrubium album vulgare C. B. Pin.* 230. White Horehound.

— — — — — — 569. *Marrubium album, anguſtifolium peregrinum C. B. Pin.* 230. Narrow-leaved Candy Horehound.

— — — — — — 570. *Marrubium album, latifolium peregrinum C. B. Pin.* 230. Broad-leaved white Horehound.

N° 440. *p.* 175. — 1734. 631. *Medicago annua, Trifolii facie T. Inſt. p.* 412. Annual Moon-Trefoil.

— — — — — — 632. *Medicago maritima, trifolia, annua, polycarpus, fructu toroſo, non ſpinoſo,* D. Micheli *Hort. Piſ. p.* 110. Annual, Maritime Moon-Trefoil, with a ſmooth Seed.

N° 431. *p.* 201. Ann. 1732. 538. *Meliſſa Americana, graveolens a Domino Houſton.* Strong-ſmelling *American* Baum.

N° 456. *p.* 293. — 1738. 836. *Meniſpermum Canadenſe, ſcandens umbilicato folio Ac. R. Sc.* 1705. Climbing *Canada* Moon-Seed, with an umbilicated Leaf.

— — — — — — 837. *Meniſpermum umbilicato folio, mucronato, ad baſin non ſinuato.* Moon-Seed with an umbilicated, pointed Leaf, not ſinuated at the Baſe.

— — — — — — 838. *Meniſpermum hederaceo folio.* Moon-Seed with an Ivy Leaf.

N° 457. *p.* 408. — 1739. 881. ☉*Mentha anguſtifolia ſpicata C. B.* 227. Spear-Mint, *or* Hart-Mint.

— — — — — — 882. *Mentha anguſtifolia, altera, rugoſior, ſpica hirſuta.* Rough Spear-Mint, with a hairy Spike.

N° 436. *p.* 2. — 1733. 571. *Mentha hortenſis prior Fuchſ. Hiſt.* 288.

— — — — — — 573. *Mentha hortenſis verticillata, Ocimi odore* C. B. Pin. 227. *Mentha quarta Dod. Pempt.* 95. Red Mint.

— — — — — — 577. *Mentha Piperitis* Off. Lond. *Mentha ſpicis brevioribus & habitioribus, foliis Menthæ fuſcæ, ſapore fervido Piperis* Raii *Syn. Ed.* 3. *p.* 234. Pepper Mint.

— — — — — — 572. *Mentha prima Dod. Pempt.* 95.

N° 471. *p.* 621. — 1740. 934. *Mentha rotundifolia, odore Menthæ Romanæ, verticillis minimis Rand.* Round-leaved Mint, with very ſmall Whorls.

N° 436. *p.* 2. — 1733. 574. *Mentha ſylveſtris, rotundiore folio C. B. Pin.* 227. Horſe-Mint, *or* round-leaved wild Mint.

— — — — — — 575. *Mentha ſylveſtris, rotundiore folio, purpureo flore Bot. Monſp.* Round-leaved Horſe-Mint, with a purple Flower.

— — — — — — 576. *Mentha ſylveſtris, ſpicata, latifolia, hirſuta.* Hairy, broad-leaved, ſpiked wild Mint.

N° 457. *p.* 408. — 1739. 883. *Mentha verticillata, longiori acuminato folio, odore aromatico.* Whorled Mint,

Mint, with a long pointed Leaf, and an aromatic Smell.

N° 471. *p.* 621. Ann. 1740. 935. *Menthaſtrum* Off. *Menthaſtrum ſpicatum, folio longiore candicante J. B.* Long-leaved Horſe-Mint.

— — *p.* 622. — — 936. *Millefolium purpureum vulgare Raii.* Purple common Yarrow, *or* Milfoil.

N° 445. *p.* 2. — 1735. 669. *Milleria, amplis ſcrophulariæ foliis, maculatis.* Milleria, with large, ſpotted, Fig-wort Leaves.

N° 431. *p.* 201. — 1732. 539. *Milleria Parietariæ folio, capitulis congeſtis, planis. D. Houſton.* Milleria, with Pellitory Leaves, and plain Flowers, heaped together.

— — — — — 540. *Milleria Scrophulariæ amplo folio, floribus laxe ſpicatis. D. Houſton.* Milleria, with a large Fig-wort Leaf, and Flowers in looſe Spikes.

N° 436. *p.* 3. — 1733. 578. *Molucca lævis Dod. Pempt.* 92. Smooth *Molucca* Baum.

— — — — — 579. *Momordica vulgaris T. Inſt. p.* 103. Male Balſam-Apple.

— — — — — 580. *Momordica Zeylanica pampineæ fronde, fructu longiori* T. Inſt. p. 103. *Pandi Pavel. Hort. Mal.* 8. 17. Balſam-Apple of *Ceylon*, with a Vine-Leaf, and a longer Fruit.

N° 445. *p.* 2. — 1735. 670. *Myoſotis hirſuta minor T. Inſt.* 245. Small, hairy, Mouſe-Ear Chickweed.

N° 447. *p.* 145. — 1736. 732. *Nerion floribus rubeſcentibus C. B.* 464. Oleander *or* Roſe-Bay.

N° 445. *p.* 2. — 1735. 671. *Nicotiana major anguſtifolia C. B.* 170. Narrow-leaved Tobacco.

— — — — — 672. *Nicotiana major, anguſto, longoque folio, caulem fere amplectente.* Tobacco with a long, narrow Leaf, almoſt embracing the Stalk.

— — — — — 673. *Nicotiana latifolia major; albo flore. Ex Inſula Tobago.* Broad-leaved Tobacco, with a white Flower.

N° 431. *p.* 202. — 1732. 543. *Nigella anguſtifolia, flore majore, ſimplici, cæruleo C. B.* Narrow-leaved Fennel-Flower, with a large, ſingle, blue Flower.

N° 471.

N° 471. *p.* 622. Ann. 1740. 937. *Nigella arvenſis cærulea. C. B.* Wild, horned Fennel-Flower.

N° 431. *p.* 202. — 1732. 542. *Nigella, flore minore, ſimplici, candido C. B.* 145. Fennel-Flower with a ſmall, white, ſingle Flower.

— — *p.* 201. — — 541. *Nigella Orientalis; flore flaveſcente; ſemine alato, plano. T. Cor.* 19. Oriental Fennel-Flower, with a yellow Flower, and a flat winged Seed.

N° 445. *p.* 2. — 1735. 674. *Nummularia major, lutea C. B.* 309. Money-wort, *or* Herb Two-pence.

N° 457. *p.* 408. — 1739. 884. *Oldenlandia humilis, Hyſſopifolia Plum. N. G.* 42. Dwarf Hyſſop-leaved *Oldenlandia.*

N° 436. *p.* 3. — 1733. 581. *Omphalodes pumila verna; Symphyti folio T. Inſt.* 140. Low, vernal *Venus* Navel-wort, with a Comfry-Leaf, *or* leſſer Borage.

— — — — — — 582. *Onagra Bonarienſis villoſa, flore mutabili Hort. Elt.* 297. *Tab.* 219. Hairy Tree-Primroſe, with a changeable Flower.

N° 447. *p.* 145. — 1736. 733. *Orchis galea & alis fere cinereis J. B.* II. 735. The Man Orchis.

N° 471. *p.* 622. — 1740. 938. *Oſtrys Americana fructu Lupuli. Ind. Hort. Chelſ. American* Hop Hornbeam.

N° 457. *p.* 408. — 1739. 885. *Oxys lutea, Americana, procumbens.* Procumbent, *American*, yellow Wood-Sorrel.

N° 471. *p.* 622. — 1740. 939. *Parietaria Polygoni folio, caneſcens.* Hoary Pellitory, with a Knot-Graſs Leaf.

N° 447. *p.* 145. — 1736. 734. *Parnaſſia paluſtris & vulgaris* T. Inſt. 240. *Gramen Parnaſſi, albo ſimplici flore. C. B.* 309. Graſs of *Parnaſſus.*

N° 436. *p.* 3. — 1733. 583. *Paronychia Hiſpanica Cluſ. Hiſt.* clxxxii. Silver ſcaly-headed Mountain Knot-Graſs.

N° 445. *p.* 2. — 1735. 675. *Paſtinaca ſylveſtris, latifolia, Auſtriaca D. Boerhaave. Auſtrian* wild Parſnep.

N° 440. *p.* 175. — 1734. 633. *Perſicaria perennis, repens, latifolia.* Broad-leaved, creeping, perennial Arſmart.

N° 457. *p.* 408. Ann. 1739. 886. *Pervinca vulgaris, anguſtifolia T.* 120. Narrow-leaved Periwinkle.

— — — — — — 887. *Petaſites major & vulgaris C. B.* 197. Butter-bur, *or* Peſtilent-wort.

— — — — — — 888. *Petaſites major, floribus albis, ſpica bipedali* D. Bobart. *Petaſites major, floribus pediculis longis inſidentibus R. Syn.* 111. 179. Butter-bur, with Flowers on long Pedicles.

— — — — — — 889. *Petaſites minor, folio Tuſſilaginis Mor. H. Reg. Bleſ.*

N° 452. *p.* 3. — 1737. 786. *Petiveria Solani foliis; loculis ſpinoſis* Plum. Nov. Gen. 50. *Verbenæ aut Scorodoniæ affinis, anomala, flore albido; calyce aſpero; allii odore.* Sloane *Cat. Jam.* 64. *Guinea* Hen-Weed. Hiſt. 1. 172.

N° 457. *p.* 408. — 1739. 890. *Phlomis acuminato, viridi, ſplendente folio; flore purpuraſcente, caulibus villoſis.* Sage-Tree, *or Jeruſalem* Sage, with a ſhining, green, pointed Leaf, a purple Flower, and hairy Stalks.

— — — — — — 891. *Phlomis Hiſpanica, fruticoſa, candidiſſima, flore ferrugineo T. Inſt.* 178. White, ſhrubby *Spaniſh* Sage-Tree, *or* Sage of *Jeruſalem.*

— — — — — — 892. *Phlomis Narbonenſis, Hormini folio, flore purpuraſcente T. Inſt.* 178. *Narbonne Jeruſalem* Sage, with a clary Leaf, and purpliſh Flower.

N° 436. *p.* 3. — 1733. 584. *Phytolacca Americana majori fructu.* T. Inſt. 299. *Solanum magnum Virginianum rubrum Park. Theat.* 347. *Virginian* Poke, *or* Pork Phyſick.

— — — — — — 586. *Phytolacca Americana, minor, bacca monopyrena. Solanoides Pariſienſium.* Small *American* Nightſhade, with one Seed in a Berry.

N° 457. *p.* 409. — 1739. 893. *Phytolacca fructu monopyreno, majore, folio longiore, glabro. American* Nightſhade, with a large Berry, and one Seed, and a long, ſmooth Leaf.

N° 476. *p.* 3. — 1733. 585. *Phytolacca Mexicana, baccis ſeſſilibus Hort. Elt.* 318. *Mexican* Nightſhade, with ſeſſile Berries.

N° 457. *p.* 409. Ann. 1733. 894. *Piloſella major, umbellifera, macrocaulos. Floribus eſt floſculoſis Col. Ecph.* 248. Great umbelliferous Mouſe-Ear.

N° 456. *p.* 293. — 1738. 839. *Pinus Halepenſis; foliis tenuibus, læte virentibus. Aleppo* Pine, with ſlender, bright green Leaves.

— — — — — — 840. *Polium erectum minus anguſtifolium.* An *Polium Hiſpanicum tenuifolium, flore albo, capitulo breviori T.* 207. Small, narrow-leaved, upright Poley-Mountain.

N° 447. *p.* 146. — 1736. 737. *Polygonatum latifolium, flore majore, odoro C. B.* 303. *Solomon's* Seal, with a large, ſweet-ſmelling Flower.

— — — — — — 738. *Polygonatum latifolium vulgare C. B.* 303. Common *Solomon's* Seal.

— — — — — — 739. *Polygonatum majus, vulgari, ſimile J. B.* 111. 529. The greateſt *Solomon's* Seal.

— — *p.* 145. — — 735. *Polypodium Cambro-britannicum; pinnulis ad margines laciniatis Raii Syn. Ed.* 11. *p.* 35. Laciniated Polypody of *Wales.*

— — *p.* 146. — — 736. *Polypodium murale, pinnulis ſerratis Petiver Bot. Hort.* Wall Polypody, with ſerrated Leaves.

N° 471. *p.* 622. — 1740. 940. *Polypodium ſenſibile Munting. Hiſt.* Senſitive Polypody.

N° 456. *p.* 293. — 1738. 841. *Populus nigra, folio maximo; gemmis Balſamum odoratiſſimum fundentibus* Cateſ. *Hiſt. Tab.* 34. Large-leaved, odoriferous black Poplar.

N° 447. *p.* 146. — 1736. 740. *Prenanthes Americana, folio lato, bipennem militarem referente; flaveſcente flore. American* Prenanthes, with a broad Leaf, and a yellowiſh Flower.

N° 471. *p.* 622. — 1740. 941. *Pſeudo-Dictamnus verticillatus odorus C. B.* Sweet-ſmelling baſtard Dittany.

N° 445. *p.* 3. — 1735. 676. *Pſyllium anguſtifolium, perenne. Pſyllium majus ſupinum C. B.* 191. Perennial, narrow-leaved Flea-wort.

N° 445. *p.* 3. — 1735. 677. *Pſyllium majus, erectum, anguſtifolium, annuum.* Great, upright, narrow-leaved, annual Flea-wort.

— — — — — — 678. *Pſyllium Dioſcoridis, vel Indicum, crenatis foliis C. B.* 191. *Indian* Flea-wort, with notched Leaves.

— — — — — — 679. *Pſyllium majus, erectum, latifolium, annuum. Pſyllium majus, erectum C. B.* 191. Annual, broad-leaved, upright, great Flea-wort.

N° 436. *p.* 3. — 1733. 587. *Ptarmica Orientalis, Santolinæ, folio flore minori T. Cor.* 37. Oriental Sneezwort, with a *Santolina* Leaf, and a ſmaller Flower.

N° 440. *p.* 175. — 1734. 634. *Pulegium anguſtifolium* C. B. 222. *Pulegium Cervinum Offic.* Hart Penny-royal.

— — — — — — 635. *Pulegium anguſtifolium flore albo H. Reg. Par.* Hart Penny-royal, with a white Flower.

This Plant is almoſt 3 Times as big as the preceding.

— — — — — — 636. *Pulegium latifolium C. B.* 222. Penny-royal, *or* Pudding-Graſs.

— — — — — — 637. *Pulegium latiſolium erectum.* Upright, broad-leaved Penny-royal.

N° 447. *p.* 146. — 1736. 741. *Pulegium minimum, Serpylli facie.* The leaſt Penny-royal, with the Appearance of Mother of Thyme.

N° 431. *p.* 202. — 1732. 544. *Pulmonaria calyce veſicario.* Lungwort, with a Bladder-like Empalement.

N° 452. *p.* 3. Ann. 1737. 787. *Pyrethrum* Officinarum. *Pyrethrum flore Bellidis* C. B. 148. *Chamæmelum ſpecioſo flore, radice longa, fervida* D. Shaw. *Phyt. Afric. Spec.* N° 138. Pellitory of *Spain.*

— — *p.* 4. — — — 788. *Pyrethrum fruteſcens Canarienſe, Leucanthemum Canarienſe, foliis Chryſanthemi, Pyrethri ſapore T. Inſt.* 666. Shrubby *Pyrethrum* of the *Canary* Iſlands.

— — — — — — 789. *Rapuntium Americanum, flore dilute cæruleo Ac. Reg. Par. American* Rampion, with a pale, blue Flower.

N° 436.

N° 436. *p.* 3. Ann. 1733. 588. *Rapuntium Trachelii folio, flore purpuraſcente Plum. Cat. p.* 5. Rampion with a Throat-wort Leaf, and a purpliſh Flower.

N° 452. *p.* 4. —— 1737. 790. *Rapuntium Virginianum, foliis oblongis, floribus parvis cæruleis; ſpica longiſſima, laxa. Virginian* Rampion, with oblong Leaves, ſmall blue Flowers, and a very long, looſe Spike.

— — — — — 791. *Reſeda alba J. B.* 111. 467. Great, white Baſtard Rocket.

— — — — — — 792. *Reſeda criſpa Gallica Bocc. Rar.* 76. Curled Baſtard Rocket.

N° 436. *p.* 3. —— 1733. 589. *Ricinoides Americana, Alni folio, oblongo. A D^mo Houſton.* An *Ricinoides Americana Caſtaneæ folio* Plum. *Cat. p.* 20. *American* Phyſicknut, with an oblong Alder-Leaf.

N° 445. *p.* 3. —— 1735. 680. *Roſa moſchata flore pleno C. B.* 482. Muſk-roſe, with a double Flower.

N° 457. *p.* 409. — 1739. 895. *Roſa Pimpinellæ folio, Scotica, flore eleganter variegato. Roſa Ciphiana* Sibbald *Scot. Illuſt.* Striped *Scotch* Roſe.

N° 445. *p.* 3. —— 1735 681. *Roſa rubra, plena, ſpinoſiſſima, pedunculo muſcoſo Boerh. Ind. alt.* 252. Moſs Roſe.

N° 457. *p.* 409. — 1739. 896. *Roſa ſylveſtris, Virginienſis.* Wild *Virginian* Roſe.

N° 445. *p.* 3. —— 1735. 682. *Salicaria Hyſſopi folio latiore T. Inſt.* 253. Graſs-Poly, ſmall Hedge-Hyſſop.

N° 447. *p.* 146. — 1736. 742. *Salvia Africana fruteſcens; folio Scorodoniæ; flore violaceo H. Amſt.* 2. 181. Shrubby *African* Sage, with a Wood-Sage Leaf, and a Violet coloured Flower.

N° 456. *p.* 293. — 1738. 842. *Saxifraga rotundifolia alba C. B.* 309. White Saxifrage.

— — — — — — 843. *Saxifraga verna, annua, humilior T.* 252. *Sedum tridactylites tectorum C. B.* Rue Whitlow-Graſs.

N° 445.

N° 445. *p.* 3. Ann. 1735. 683. *Scabiosa capitulo globoso, foliis in tenuissimus lacinias divisis* C. B. 271. Field-Scabious, with Leaves cut into very fine Segments.

— — — — — — 684. *Scabiosa capitulo globoso major* C. B. 270. *Scabiosa minor Matthioli.* Great Scabious, with a globose Head.

— — — — — — 685. *Scabiosa capitulo globoso, major, acutiore folio, tenuiter dissecto.* Great Scabious, with a globose Head, and a sharp-pointed Leaf, cut into very fine Segments.

— — — — — — 686. *Scabiosa capitulo globoso, tenuifolia, pediculis florum prælongis.* An *Scabiosa capitulo globoso minor* C. B. Scabious, with a globose Head, fine cut Leaves, and very long Pedicles to the Flowers.

— — — — — — 687. *Scabiosa peregrina, rubra*; *capitulo oblongo* C. B. 270. *foliis integris.* Red Scabious, with an oblong Head, and entire Leaves.

N° 436. *p.* 3. — 1733. 590. *Scabiosa stellata, Orientalis*; *floscu-lis marginalibus fimbriatis.* Starred, oriental Scabious, with the marginal Flowers fimbriated.

N° 440. *p.* 175. — 1734. 638. *Scorpioides Bupleuri folio* C. B. *Pin.* 287. Prickly Caterpillars.

— — *p.* 176. — — 639. *Scorpioides siliqua crassa Boelii Ger. Emac. App.* 1627. Caterpillar with a thick Pod.

— — — — — — 640. *Scorpioides siliqua striata, minus aspera.* Smoother Caterpillar, with a striped Pod.

— — — — — — 641. *Scrophularia flore luteo* C. B. 236. Yellow flowered Figwort.

— — — — — — 642. *Scrophularia folio Urticæ* C. B. 236. *Scrophularia peregrina Cam. Hort. Icon.* 43. Nettle-leaved Figwort.

— — — — — — 643. *Scrophularia Lamii folio D. Bobart.* Figwort with an Archangel Leaf.

— — — — — — 644. *Scropularia nemorensis*; *folio Urticæ rugoso*; *flore atro-punicante H. C.* Boer.

Boer. *Ind. alt.* 234. Figwort, with a rough Nettle Leaf, and a dark-red Flower.

N° 440. *p.* 176. Ann. 1734. 645. *Scrophularia Orientalis, foliis Cannabinis T. Cor.* 9. Oriental Figwort, with Hemp-Leaves.

— — — — — — 646. *Scrophularia ſaxatilis lucida, Laſerpitii Maſſilienſis foliis* Bocc. Muſ. 166. Shining, Rock Figwort, with the Leaves of Laſerwort of *Marſeilles.*

— — — — — — 647. *Scrophularia Scorodoniæ folio Mor. Hiſt. Ox.* 482. Figwort, with a Wood-Sage Leaf.

N° 457. *p.* 409. — 1739. 897. *Senecio Americanus, folio haſtato, nitide ſerrato. American* Groundſel, with a haſtated Leaf, neatly ſerrated.

N° 471. *p.* 622. — 1740. 942. *Senna Italica, ſive foliis obtuſis C. B. Italian* Senna.

N° 456. *p.* 293. — 1738. 844. *Serratula Marilandica, foliis glaucis, Cirſii inſtar denticulatis H. Elt.* 354. Saw-wort of *Maryland*, with glaucous, indented Leaves, like *Cirſium.*

N° 431. *p.* 202. — 1732. 545. *Sherardia nodiflora; Stœchados ſerratæ foliis D. Vaillant.* Sherardia flowering at the Joints, with the Leaves of ſerrated *Stœchas.*

— — — — — — 546. *Sherardia repens, nodiflora, ſubrotundo folio D. Houſton.* Creeping Sherardia, flowering at the Joints, with a roundiſh Leaf.

— — — — — — 547. *Sherardia ſpicata, annua; flore cæruleo; foliis anguſtis, & ſerratis D. Houſton.* Annual, ſpiked Sherardia, with a blue Flower, and narrow, ſerrated Leaves.

N° 471. *p.* 622. — 1740. 943. *Sideritis Romana, utriculis ſpinoſis H. L. Bat. Roman* Iron-wort, with prickly Empalements.

N° 447. *p.* 146. — 1736. 743. *Sinapi Hiſpanicum pumilum album T. Inſt.* 227. Dwarf, white, *Spaniſh* Muſtard.

N° 431. *p.* 202. Ann. 1732. 548. *Sinapiſtrum Americanum, ſpinoſum; flore carneo; foliis trifidis & quinquefidis D. Houſton.*

N° 447. *p.* 146. — 1736. 744. *Sium aromaticum, Siſon Officinarum* T. Inſt. 308. *Siſon quod* Amomum *Officinis noſtris C. B.* 154. Baſtard Stone-Parſley.

N° 457. *p.* 409. — 1739. 898. *Sium umbellatum repens Ger. Emac.* 256. Creeping Water-Parſnep.

N° 445. *p.* 4. — 1735. 693. *Solanum Americanum, glabrum, acinis puniceis, majoribus.* Smooth *American* Nightſhade, with great, red Berries.

N° 457. *p.* 409. — 1739. 899. *Solanum fruticoſum, Africanum, Lauri foliis.* Shrubby, *African* Nightſhade, with Bay-Leaves.

N° 452. *p.* 4. — 1737. 793. *Solanum fruticoſum, bacciferum C. B.* 166. Tree Nightſhade.

N° 445. *p.* 4. — 1735. 694. *Solanum Guineenſe; fructu Ceraſi nigri forma & magnitudine D. Juſſieu.* Nightſhade of *Guinea*, with a Fruit of the Form and Size of a black Cherry.

— — *p.* 3. — — 688. *Solanum hortenſe; ſinuatis foliis; acinis ſaturate virentibus.* Garden Nightſhade, with ſinuated Leaves, and dark-green Berries.

— — — — — — 689. *Solanum nigricans, hortenſi ſimile, elatius, Virginianum, flore foris purpuraſcente.* Blackiſh *Virginian* Nightſhade, like the common one, but larger, with a Flower purpliſh on the Outſide.

— — — — — — 690. *Solanum nigricans, hortenſi ſimile, minore flore & fructu.* Ex Inſula *Tobago.* Blackiſh Nightſhade, like the common one, with a ſmaller Flower and Fruit. *From the Iſland* Tobago.

— — — — — — 691. *Solanum Officinarum; acinis luteis C. B.* 166. Common Nightſhade, with yellow Berries.

— — *p.* 4. — — — 692. *Solanum Officinarum; acinis puniceis C. B.* 166. Common Nightſhade, with red Berries.

N° 431. *p.* 202. — 1732. 549. *Spergula quæ Alſine ſaxatilis & multiflora; capillaceo folio T. Inſt.* 243. Many-

Many-flowered Rock Chickweed, with a capillaceous Leaf.

N° 436. *p.* 591. Ann. 1733. 591. *Spermacoce verticillis tenuioribus. Hort. Elt. Tab.* 277. *f.* 259. Spermacoce with ſlenderer Whorls.

N° 456. *p.* 294. — 1738. 645. *Stramonium*; *foliis ſubrotundis, & denticulatis.* Thorn-Apple with roundiſh, ſinuated, and indented Leaves.

N° 436. *p.* 3. — 1733. 592. *Symphoricarpos*; *foliis alatis Hort. Elt.* 371. *Tab.* 278. Symphoricarpos with winged Leaves.

— — *p.* 4. — — — 593. *Tanacetum Africanum, arboreſcens, foliis Lavendulæ, multifido folio. Hort. Amſt.* 2. *p.* 201. *African*, arboreſcent Tanſey, with Lavender Leaves, and a multifid Leaf.

— — — — — — 594. *Telephioides Græca, humifuſa*; *flore albo T. Cor.* 50. *Greek*, procumbent *Telephioides*, with a white Flower.

N° 445. *p.* 4. — 1735. 695. *Teucrium Hiſpanicum, latiore folio T. Inſt.* 208. *Spaniſh* Tree-Germander, with a broader Leaf.

N° 456. *p.* 294. — 1738. 846. *Thapſia latifolia villoſa C. B.* 348. Broad-leaved, hairy *Thapſia.*

N° 471. *p.* 622. — 1740. 944. *Thlaſpi* Off. *Thlaſpi arvenſe, ſiliquis latis.* Treacle-Muſtard, *or* Penny-creſs.

— — — — — — 943. *Thlaſpi arvenſe, minus, luteum Park.* Small, yellow Treacle-Muſtard.

N° 445. *p.* 4. — 1735. 696. *Thlaſpidium Apulum, ſpicatum T. Inſt.* 215. Spiked Apulian *Thlaſpidium.*

N° 452. *p.* 4. — 1737. 794. *Thlaſpidium fruticoſum*; *Leucoii folio*; *ſemper florens* T. Inſt. 214. *Thlaſpi fruticoſum, Perſicum, foliis Keiri, flore odorato Zanon.* 196. Everflowering ſhrubby *Thlaſpidium*, with a Wall-Flower Leaf.

N° 447. *p.* 146. — 1736. 745. *Tilia Caroliniana*; *foliis acuminatis. Carolina* Lime-Tree, with pointed Leaves.

N° 436. *p.* 4. — 1733. 595. *Tithymalus Americanus, ramoſiſſimus*; *Ocimi minoris folio.* Branched *American* Spurge, with a Leaf like ſmall Baſil. *From Dr* Houſton.

N° 440. *p.* 176. Ann. 1734. 648. *Tragopogon gramineo folio, ſuave-rubente flore. Col.* 291. Graſs-leaved Goat's Beard, with a fine red Flower.

— — — — — — 649. *Tragopogon luteum, foliis gramineis; caule purpuraſcente Boer. Ind. Alt. p.* 90. Yellow Goat's Beard, with graſſy Leaves, and a purpliſh Stalk.

N° 452. *p.* 4. — 1737. 795. *Trichomanes ſive Polytrichum Officinarum C. B.* 556. *Engliſh* black Maiden-Hair.

N° 436. *p.* 4. — 1733. 596. *Turnera fruteſcens Ulmi folio Plum. Nov. Gen. p.* 15. Broad-leaved Turnera.

N° 436. *p.* 4. — 1733. 597. *Turnera Lycopi folio; flore ampliore. Ciſtus Urticæ folio, flore luteo; vaſculis trigonis* Sloan *Hiſt. Vol. I. Tab.* 127. *Fig.* 4 & 5. Narrow-leaved *Turnera*, with a large Flower.

N° 452. *p.* 4. — 1737. 796. *Turritis vulgaris ramoſa* T. Inſt. 224. *Piloſella ſiliquata* Thalii *Tab.* vii. Codded Mouſe-Ear.

— — — — — — 797. *Turritis Leucoii folio T. Inſt.* 224. Treacle Wormſeed.

— — — — — — 798. *Turritis Leucoii folio; floribus amplioribus.* Treacle Wormſeed, with larger Flowers.

— — — — — — 799. *Ulmaria* Cluſ. Hiſt. cxcviii. *Barba Capræ floribus compactis C. B.* 164. Meadow-ſweet.

— — — — — — 800. *Ulmaria floribus in longas ſpicas congeſtis* Boerh. Ind. Alt. 295. *Barba Capræ floribus oblongis C. B.* 163. Goat's Beard, with Flowers in long Spikes.

N° 471. *p.* 946. — 1740. 946. *Urtica pilulifera Parietariæ foliis Hort. Reg. Pariſ. Spaniſh* Marjoram.

— — *p.* 622. — — 947. *Valerianella ſemine ſtellato C. B.* Corn-Sallet, with a ſtarred Seed.

N° 445. *p.* 4. — 1735. 697. *Verbena Americana, humilior; Urticæ longiori folio; ſpica fere ſimplici; flore albo.* Low *American* Vervain, with

with a long Nettle Leaf, an almoſt ſingle Spike, and a white Flower.

N° 445. *p.* 4. Ann. 1735. 698. *Verbena Americana*; *ſpica multiplici laxa.* An *Verbena Caroliniana*; *Meliſſæ folio aſpero Hort. Elth.* 407. *American* Vervain, with a manifold looſe Spike.

N° 456. *p.* 294. — 1738. 847. *Verbena Bonarienſis altiſſima*; *Lavendulæ Canarienſis ſpica multiplici H. Elt.* Tall Vervain, with a manifold Spike.

N° 445. *p.* 4. — 1735. 699. *Verbena Luſitanica, latifolia, procerior T. Inſt.* 200. Taller, broad-leaved *Portugal* Vervain.

— — — — — 700. *Verbena peregrina, foliis Urticæ Dod. Mem.* Foreign Vervain, with Nettle Leaves.

N° 447. *p.* 146. — 1736. 746. *Veronica Cymbalariæ folio, verna* T. Inſt. 145. *Alſine Hederulæ folio C. B.* 250. Ivy Chickweed, *or* ſmall Henbit.

— — — — — 747. *Veronica floſculis oblongis inſidentibus*; *Chamædryos foliis alternis H. L. Bat.* 622. Germander Speedwell, with alternate Leaves, and Flowers on long Stalks.

— — — — — 748. *Veronica mas ſupina & vulgatiſſima C. B.* Male Speedwell, *or* Fluellin.

N° 436. *p.* 4. — 1733. 598. *Virga aurea major, foliis glutinoſis & graveolentibus T. Inſt.* 484. Great golden Rod, with glutinous, ſtrong-ſmelling Leaves.

N° 456. *p.* 294. — 1738. 848. *Virga aurea Marilandica, cæſia, glabra H. Elt.* 414. Smooth, glaucous golden Rod of *Maryland.*

— — — — — 849. *Virga aurea Novæ Angliæ, lato, rigidoque folio Par. Bat. New England* golden Rod, with a broad, ſtiff Leaf.

N° 447. *p.* 146. — 1736. 749. *Virga aurea, ſeu Solidago procerior, Americana*; *caule multiplici* Pluk. *Phyt.* 235. *f.* 5. Tall, *American* golden Rod, with a manifold Spike.

— — — — — 750. *Virga aurea Virginiana annua Zanon.* 205. Annual golden Rod of *Virginia.*

N° 436. *p.* 4. Ann. 1733. 599. *Virga aurea, Ulmi folio, Virginiana. Virga aurea, Americana, aſpera, foliis brevioribus ſerratis Hort. Elt.* 411. *American*, rough golden Rod, with ſhort, ſerrated Leaves.

N° 456. *p.* 294. — 1738. 850. *Virga aurea vulgaris latifolia J. B.* 11. 1062. Common golden Rod.

N° 436. *p.* 4. — 1733. 600. *Vitex foliis anguſtioribus; Cannabis modo diſpoſitis C. B. Pin.* 475. The chaſte Tree.

N° 431. *p.* 202. — 1733. 550. *Volubilis Americana, Bryoniæ folio; hirſutia lappacea obſita*, a D. Houſton. *Gronovia ſcandens, lappacea, pampinea fronde* Houſton. *Martyn. Hiſt. Plant. rar. Dec.* iv. N° 8. Climbing, rough Gronovia, with a Vine Leaf.

N° 457. *p.* 409. — 1739. 900. *Vulneraria erecta, annua flore ſubrotundo, leviter crenato. Loto affinis, Coryli folio* Dod. *Mem.* Upright, annual Wound-wort, with a roundiſh Leaf, ſlightly crenated.

N° 471. *p.* 622. — 1740. 949. *Vulneraria flore purpuraſcente Tourn.* Wound-worth, with a purpliſh Flower.

— — — — — — 950. *Vulneraria pentaphyllos* Tourn. *Anthyllis leguminoſa, veſicaria Hiſpanica Park.* 1094. Five-leaved Wound-wort.

— — — — — — 948. *Vulneraria ruſtica* J. B. *Anthyllis leguminoſa* Raii *Syn.* Kidney-Vetch, *or* Lady's Finger.

N° 440. *p.* 650. — 1734. 650. *Xeranthemum flore ſimplici, purpureo, minore T. In.* 499. Smaller Sneezwort.

N. B. Part of this Catalogue containing the Plants numbered from 901 to 950, was drawn up, after the Death of Mr *Rand*, by Mr *Joſeph Miller*, Apothecary, *Hort. Chel. Præf. & Prælec. Botan.*

Some Experiments concerning the Impregnation of the Seeds of Plants, by James Logan, *Eſq*; No. 440. *p.* 192. Jan. &c 1736.

VIII. As the Notion of a Male Seed, or the *Farina Fœcundans*, in Vegetables is now very common, I ſhall not trouble you with any Obſervations concerning it, but ſuch as may have ſome Tendency to what I have to mention. And, firſt, I find from *Miller*'s Dictionary, that M. *Geoffroy*, from the Experiments he made on *Mayze*, was of Opinion, that Seeds may grow up to their full Size, and appear perfect to the Eye, without being impregnated by the *Farina*, which poſſibly, for ought I know, may in ſome Caſes be true; for there is no End of Varieties in Nature: But in the Subject he has mentioned, I have

Reaſon

Reaſon to believe it is otherwiſe, and that he applied not all the Care that was requiſite in the Management.

When I firſt met with the Notion of this Male Seed, it was in the Winter Time, when I could do no more than think of it; but in the Spring I reſolved to make ſome Experiments on the *Mayze*, or *Indian Corn*. In each Corner of my Garden, which is 40 Foot in Breadth, and near 80 in Length, I planted a Hill of that Corn, and watching the Plants when they grew up to a proper Height, and were puſhing out both the Taſſels above, and Ears below; from one of thoſe Hills, I cut off the whole Taſſels, on others I carefully opened the Ends of the Ears, and from ſome of them I cut or pinched off all the ſilken Filaments; from others I took about $\frac{1}{2}$, from others $\frac{1}{4}$, and $\frac{3}{4}$, *&c.* with ſome Variety, noting the Heads, and the Quantity taken from each: Other Heads again I tied up at their Ends, juſt before the Silk was putting out, with fine Muſlin, but the fuzzieſt or moſt nappy I could find, to prevent the Paſſage of the *Farina*, but that would obſtruct neither Sun, Air, or Rain. I faſtened it alſo ſo very looſely, as not to give the leaſt Check to Vegetation.

The Conſequence of all which was this, that of the 5 or 6 Ears on the firſt Hill, from which I had taken all the Taſſels, from whence proceeds the *Farina*, there was only one that had ſo much as a ſingle Grain in it, and that in about 480 Cells, had but about 20 or 21 Grains, the Heads, or Ears, as they ſtood on the Plant, looked as well to the Eye as any other; they were of their proper Length, the Cores of their full Size, but to the Touch, for want of the Grain, they felt light and yielding. On the Core, when diveſted of the Leaves that cover it, the Beds of Seed were in their Ranges, with only a dry Skin on each.

In the Ears of the other Hills, from which I had taken all the Silk, and in thoſe that I had covered with Muſlin, there was not ſo much as one mature grown Grain, nor other than as I have mentioned in the firſt: But in all the others, in which I had left Part, and taken Part of the Silk, there was in each the exact Proportion of full Grains, according to the Quantity or Number of the Filaments I had left on them. And for the few Grains I found on one Head in the firſt Hill, I immediately accounted thus: That Head, or Ear, was very large, and ſtood prominent from the Plant, pointing with it's Silk Weſtward directly towards the next Hill of *Indian* Corn; and the *Farina*, I know, when very ripe, on ſhaking the Stalk, will fly off in the fineſt Duſt, ſomewhat like Smoak. I therefore, with good Reaſon, judged that a Weſterly Wind had wafted ſome few of theſe Particles from the other Hill, which had light on the Stiles of this Ear, in a Situation perfectly well fitted to receive them, which none of the other Ears, on the ſame Hill, had. And indeed I admire that there were not more of the ſame Ear than I found impregnated in the ſame Manner.

As I was very exact in this Experiment, and curious enough in my Obſervations, and this, as I have related it, is truly Fact, I think it may reaſonably be allowed, that notwithſtanding what M. *Geoffroy* may

have

have delivered of his Trials on the same Plant, (as I am positive, by my Experiment on those Heads, from which Silk was taken quite away, and those that were covered with Muslin) none of the Grains will grow up to their Size, when prevented of receiving the *Farina* to impregnate them, but appear, when the Ears of Corn are disclosed, with all the Beds of the Seeds, or Grains, in their Ranges, with only a dry Skin on each, about the same Size as when the little tender Ears appear filled with milky Juice before it puts out it's Silk. But the few Grains that were grown on the single Ear, were as full and as fair as any I had seen, the Places of all the rest had only dry empty Pellicles, as I have described them; and I much question whether the same does not hold generally in the whole Course of Vegetation, though, agreeable to what I first hinted, it may not be safe to pronounce absolutely upon it, without a great Variety of Experiments on different Subjects. But I believe there are few Plants that will afford so fine an Opportunity of observing on them as the *Mayze*, or our *Indian Corn*; because it's Stiles may be taken off or left on the Ear, in any Proportion, and the Grains be afterwards numbered in the Manner I have mentioned.

The Discovery of a perfect Plant in Semine, *by Mr* Henry Baker. No. 457. *p.* 448. July. *&c.* 1740.

IX. Since the ancient Supposition of *equivocal Generation* has been rejected, for a more reasonable Belief, that every Thing proceeds from Parents of it's own Kind, Numbers of curious People have busied themselves in Search of Experiments, whereby to demonstrate the Truth of the latter, and consequently the Falsity of the former Opinion. For this Purpose the *Animal* and *Vegetable* Worlds have been examined, and such Analogy found between them, as proves convincingly, that their *Generation* and *Increase* are brought about in a Manner pretty much alike. The animal and vegetable *Semina* are found to be alike the *Rudiments* of their future Offspring; and both alike require only a proper Repository to preserve them from Injuries, and proper Juices to advance their Growth, and bring them to Perfection.

Glasses (which the Moderns have so much improved) are the Means whereby these Secrets in Nature are discovered to us. The Eye, assisted by a good Microscope, can distinguish plainly, in the *Semen masculinum* of Animals, Myriads of *Animalcules* alive and vigorous, though so exceedingly minute, that it is computed 3000 Millions of them are not equal to a Grain of Sand, whose Diameter is but $\frac{1}{100}$ Part of an Inch: And the same Instrument will inform us beyond all Doubt, that the *Farinæ* of Vegetables are nothing else but a Congeries of minute *Granula*, whose Shapes are constant and uniform as the Plants they are taken from. And as the Seeds of Plants are found, by repeated Experiments, to be unprolific, if the *Farina* be not permitted to shed, it has been supposed, that all it's *Granula* contain *Seminal Plants* of their own Kind.

The *Growth* of Animals and Vegetables seems to be nothing else but a gradual Unfolding and Expansion of their Vessels by a slow and progressive Insinuation of Fluids adapted to their Diameters, until, being

stretched

ſtretched to the utmoſt Bounds allotted them by Providence at their Formation, they reach their State of Perfection, or, in other Words, arrive at their full Growth. If this be granted, the Conſequence muſt be, that all the Members of a perfect Animal *exiſt* really in every *Animalcule* of the *Semen animale maſculinum*, and all the Parts of a perfect Plant in every *little Grain* of the *Farina Plantarum*, however minute either of them may be.

According to this *Theory*, it is ſuppoſed by ſome, that, in *Animals*, the *Semen* of the Male being received into the *Matrix* of the Female, ſome of the *Animalcules* it contains in ſuch Abundance, find an Entrance into the *Ovaria*, and lodge themſelves in ſome of the *Ova* placed there by Providence as a proper *Nidus* for them. An *Ovum*, becoming thus inhabited by an *Animalcule*, gets looſened in due Time from it's *Ovarium*, and paſſes into the *Matrix* through one of the *Fallopian Tubes*: The Veins and Arteries that faſtened it to the *Ovary*, and were broken when it dropped from thence, unite with the Veſſels it finds here, and compoſe the *Placenta*: The Coats of the *Ovum*, being ſwelled and dilated by the Juices of the *Matrix*, form the *Chorion* and the *Amnion*, Integuments needful to the Preſervation of the *little Animal*, which, receiving continually a kindly Nouriſhment from the ſame Juices, gradually ſtretches and enlarges it's Dimenſions, becoming then quickly viſible with all the Parts peculiar to it's Species, and is called a *Fœtus*.

In *Plants*, ſay they, (which are uncapable of removing from Place to Place, as Animals can) it was requiſite a *Repoſitory* for their *Farina* ſhould be near at Hand to prevent it's being loſt; and accordingly we find, that almoſt every Flower, producing a *Farina*, has likewiſe in itſelf a proper *Ovary* for it's Reception; where the *Ova* thereby impregnated are expanded by the Juices of the *Parent Plant* to a certain Form and Bulk, and then, becoming what we call *ripe Seeds*, they fall to the *Earth*, which is a natural *Matrix* for them.

According to the above Suppoſition, a *ripe Seed*, falling to the Earth, is in the Condition of the *Ovum* of an Animal getting looſe from it's *Ovary*, and dropping into the *Uterus*: And, to go on with the Analogy, the Juices of the *Earth* ſwell and extend the Veſſels of the *Seed*, as the Juices of the *Uterus* do thoſe of the *Ovum*, till the *Seminal Leaves* unfold and perform the Office of a *Placenta* to the Infant included Plant; which, imbibing ſuitable and ſufficient Moiſture, gradually extends it's Parts, fixes it's own Root, ſhoots above the Ground, and may be ſaid to be born.

Others diſapprove of this *Hypotheſis*, and inſiſt that no *Animalcule* can poſſibly enter the *Ovum animale*, nor any Particle of the *Farina* get into the *Embryo* of a Seed: But, ſay they, in Animals, either the fineſt Part of the *Semen* is taken in by the Veſſels of the *Vagina* and *Uterus*, circulated with the Fluids, and carried into the *Ovaria*, and even into the *Ova*, by the Veſſels that run thither; or elſe, Fecundation is occaſioned by a *ſubtile Spirit* in the *Semen maſculinum*, which paſſes the *Uterus*,

Uterus, enters the *Ovaria*, pervades the Female *Ova*, actuates and enlivens the *seminal Matter* in them contained, and produces all the various Symptoms of Conception: In Plants too, say they, the same is effected by penetrating *Effluvia* from the *male Semen*, or *Farina*.

This Account of animal and vegetable Generation is intended to introduce a Discovery, which may possibly some Way lead to a greater Certainty about it.

Amongst numberless Inquirers, whom the Opinion, that every Seed includes a real Plant, has set at work to open all Kinds of Seeds, and try by Glasses to find evident Proofs thereof, I have not been the least industrious: But after repeated *Experiments*, in every Manner I could think of, and with the utmost Nicety in my Power, I began to despair of ever attaining an ocular Demonstration of it. If by moistening the Seed it began to vegetate, I could indeed discern the *seminal Leaves*, and the *Germen* or *Bud*, whence the future Plant should arise; but was able to go no further, unless I waited till the Moisture gradually extending it's Vessels made the little *Root* shoot down, the *Stalk* rise up, and the *minute Leaves* expand, and bring themselves to View. This, however, was not the Thing I sought for: But, some Days ago, mere Accident, when I thought nothing about it, favoured me with a Discovery I had so often searched after to no Purpose.

Fig. 63. Endeavouring with a fine Lancet to dissect a Seed of the *Gramen tremulum*, with Intention to examine the several Parts of it with a Microscope, imagining I might find somewhat curious in the Contexture of it's Husk, the Edges of which I observed to be transparent, I opened it the long Way exactly in the Middle, and took Notice of something exceeding small between the two Sides, which I had separated. I stuck the Point of the Lancet into it, with no other Design than to take it up, and place it in the Microscope to see what it might be; which I had no sooner done, than, to my great Surprize and Joy, I found the Lancet had fortunately opened a membranous Case, that included a *perfect Plant*, arising from a double Root in the Basis of it's said Case, with 2 Stems of an equal Height, each whereof had many Leaves upon it, like the Grass from whence it was produced. This was a Sight I little expected to meet with; and being aware how much Imagination has frequently had to do with microscopial Observations, I distrusted my own Eyes, and examined it every Way I could contrive, to prevent being deceived; but in all Positions I found it a Reality. Wherefore having secured it between two Pieces of *Isinglass*, together with the Fig. 65, 66. Cases that inclosed it, I afterwards cut open a great many Seeds of the same Sort, in Hopes I might be able to separate one of these *minute Plants* entirely from it's *Theca*; which at last I successfully effected.

A Seed

Fig. 63. *A Seed of the* Gramen tremulum *entire, of the natural Size.*
Fig. 64. *The ſame magnified.*
Fig. 65. *A Seed of the* Gramen tremulum *diſſected*, viz. A. *One Lobe or Side of the Seed.* B. *A membranous Caſe containing a minute Plant, which ariſes with* 2 *Stems bearing many Leaves from it's Radicle in the Baſis of the ſaid Caſe: This Caſe lies between the two Lobes, and, before it is opened, ſeems to be the* Germen *of the Seed.* C. *A Piece of the Caſe cut off in opening.*
Fig. 66. A. *A Lobe of the Seed.* B. *The minute Plant extracted from it's Caſe, that it's Root and Branches may be ſeen to better Advantage.* C. *The Caſe whence the minute Plant was taken.*

An Explanation of the Figures.
Fig. 63.
Fig. 64.
Fig. 65.
Fig. 66.

X. In the Edition which *Boerhaave* and *Gaubius* have given us of *Swammerdam*'s *Biblia Naturæ, ſive Hiſtoria Inſectorum*, in *Dutch* and *Latin*, 2 Vol. in Fol. printed at *Leyden* 1737, and 1738, we have an Epiſtolary Diſſertation on the Seed of the Male *Fern*, together with a very curious Cut, repreſenting the Seed-Veſſels, their Mechaniſm, and the Seed, as viewed by a good Microſcope, inſerted at the End of the ſaid Hiſtory. The Cut I have attempted, with my unſkilful Hand, to draw as well as I could; and, poſſibly, it may help you to conceive of the Form of what it is deſigned to repreſent, in ſome Meaſure.

Concerning the Seed of Fern, by the Rev. Mr Henry Miles. No. 461. *p.* 770. Aug. &c. 1741.

The Author, I find, claims to himſelf the having firſt diſcovered the Seed of *Fern*, in his Diſſertation, at the Beginning: "You rightly "judge" (ſays he to his Friend) "me to have been the firſt," *&c.* *Boerhaave* ſays, that he ſhewed them to the Botanick Profeſſor at *Leyden*, *Anno* 1673, and that he had drawn the Figures of them. But I find Dr *William Cole* ſent an Account of the Seeds of divers of the Plants called *Dorſiferous*, to Dr *Robert Hook* *, in a Letter dated *September* 30, 1669, and gives a pretty juſt Deſcription of the Seed-Veſſels, and the Manner in which they grow, and intended a Delineation of the Figures. *Swammerdam*'s great Piety, which ſhines conſpicuouſly throughout his Work, teaches me, in Charity, to conclude, he ſpake what he thought to be true; and, poſſibly, he might have made the Diſcovery many Years before the Time when he ſhewed the Seeds to the Profeſſor. However, I am humbly confident of this, (after numberleſs Trials made with all Kinds of Microſcopes, and in all Poſitions, and with different Lights) that *Swammerdam*'s Account is juſt and accurate in every Point. I have viewed the ſeveral Kinds of *Fern*, *Engliſh Maiden-Hair*, other Sorts of *Maiden-Hair*, *Wall-Rue*, *Harts-Tongue*, and find the Seed-Veſſels of the ſame Form in all, ſome little Difference being between ſome of them in the Size only; and in the Manner of their being inſerted on the Back of the Leaf, with the Numbers in

* Who was the firſt *Engliſhman* that diſcovered the Seed of the *Fern* by the Help of a Microſcope.

various Plants, there is a more conſiderable Difference. I obſerve, where you have fewer Seeds, you have more of a Sort of *Fungus*, or Tubercule, very like what is called *Jews-Ears*, which ſeems to me deſigned to ſhelter the Seeds, which grow, as under Covert, round about them. In the Female *Fern*, and *Engliſh Maiden-Hair*, the whole Surface of the Leaf on the Inſide ſeems covered, ſo the Seeds guard one another in ſome Meaſure, though in theſe I find, after the Seed-Veſſels are ſhaken off, ſmall Membranes here and there on the Surface, a little curled, looking as if they had been raiſed with the Edge of a ſharp Penknife, from the Skin of the Leaf, not altogether unlike the Pieces of Skin we are wont to raiſe in trying a Penknife on one's Hand.

Fig. 67, 68, 69, 70. The Plant which I have attempted a Figure of, with it's Seed-Veſſels, *&c.* is the *Filix mas Dodonæi*; on the Inſide of the Leaves of which are uſually ſeen ſeveral Spots placed in a regular Manner, of a Light-brown, or Ruſſet. In this Plant the principal Part of theſe Spots is the *Fungus* before-mentioned, around which the Seed-Veſſels are inſerted *.

The Seed-Veſſels conſiſt of a Stalk, by which they are inſerted into the Leaf, as *c c*, of a ſpringy ribbed Chord *e e*, having a great Number of annular Ribs, exactly reſembling the annular Cartilages in the *Aſpera Arteria*; and I know nothing in Nature ſo aptly reſembling this Chord, as the *Aſpera Arteria* of a ſmall Bird, as a *Robin* or *Nightingale*, *&c.* This Chord incircles the globular membranaceous Pod, wherein the Seed lies, adhering to it, and dividing it into two Hemiſpheres. The Pod *f f* is, in Appearance, compoſed of a fine whitiſh Membrane, ſomewhat like that which lines the Inſide of a Pea-Shell. The Seeds, Fig. 70. *k*, are irregular in Shape, and in the Surface of them, a little reſembling a Sort of Net-work, which I have endeavoured, in my rude Manner, to mimick.

In viewing this admirable Production of Divine Wiſdom in this Plant, I uſe a ſingle *Lens*, and no deep Magnifier, that I may have the Advantage of the Light falling on the Objects. I throw a Quantity of Seed-Veſſels on a circular Plate of Ivory; and, if the Plant be newly gathered, (the proper Time is about the Beginning of *September*) I often have the Pleaſure of ſeeing the Seed-Veſſels burſt; the

* Whereas I have mentioned, that a Sort of *Fungus*, of a light brown Colour, grows over the Seed-Veſſels of the *Filix mas*; this is to be underſtood to have that Appearance, when the Seeds are full ripe, and the Veſſels containing them are prepared to burſt: For I have ſince viewed them, ſoon after they begin to appear, and alſo when the Seed-Veſſels are nearly grown to their full Size; at which Times the ſaid *Fungus* is a fine Membrane of a bright Green, entirely covering the Tuft of Seed-Veſſels like a Cap, and cloſely adhering to the Surface of the Leaf of the Plant: But when the Seed-Veſſels are arrived at Perfection in Size, and able to bear being expoſed, it begins to recede from the Leaf, and to hang over them in Form of an *Umbrella*; and as they grow ripe, it gradually changes brown, and curls up a little, making the Appearance firſt-mentioned.

Tooting, January 24, 1744-5.

Motion

Fig. 60.

Fig. 61.

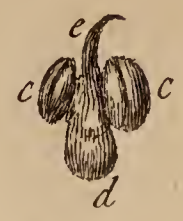


Fig. 62.

Fig. 63.

Fig. 64.

Fig. 65.

Fig. 66.

Motion of which at that Time may be ſeen by a good Eye unaſſiſted. But, when I happened to light of a Pod not thoroughly criſp, I have had the Satisfaction of ſeeing the gradual Procedure of the burſting of the Veſſel, in order to the ſcattering the Seed, in the following Manner: Firſt, the Chord breaks, and by expanding rends the *Folliculum* or Pod in two Parts: By going on to expand itſelf, as it departs from a Curve, and approaches to a right Line, it rends itſelf away from the globular Pod *gradatim*, till it be wholly diſcharged from it; when, as there can be no further Reſiſtance made to the Chord in expanding itſelf, it naturally gives a ſudden Jerk (which in this Caſe is very gentle); and thereby the Seeds are ſhed on the Surface of the Plate, in the ſame Manner as if you were to caſt ſome Grains of Corn out of a Bowl on the Plane of a Table-board: This I have ſeveral Times ſeen with unſpeakable Pleaſure; but where the Veſſel is more criſp, the Motion of it in burſting wholly eſcapes the Sight, flying away with great Violence beyond the Field which the *Lens* takes in. Sometimes I have obſerved the Pod to be 10″, ſometimes 20″ in burſting; in which Time you may have a diſtinct View of the Procedure. I would add, that I have more than once ſeen the Pod broke in the Side by ſome Accident, as at *l*; and the Seed lodged within, while the Chord has been whole, and ſtill embraced it.

One might have the Opportunity of ſeeing this curious Piece of Divine Mechaniſm to greater Advantage, if I could find a Way to get the Seed-Veſſels from the Leaves in a leſs rude Manner than by rubbing them; for they will not eaſily be diſcharged from the Leaves, (for I believe they continue a Month after the Seeds are diſperſed) ſo as to collect any Number of them together, and this Method burſts them. When I have been attempting this, they fly about like exceeding fine Vapour or Smoke, and are very troubleſome to one's Hands, *&c.* by getting into the Pores like *Cowidge*.

Fig. 71, 72, is a Repreſentation of a ſmall Piece of the Leaf of *Harts-Tongue* magnified, taken from Dr *Grew*'s Anatomy, or Hiſtory of Plants, Plate 72, referred to Book IV. Page 200. I was ſurprized to ſee that Cut ſo little reſembling the true Figure: Indeed the Doctor ſays it was a cloudy Day when he viewed the Object; and I am ſure he had no juſt Notion at all of the Spring which embraces the Pod, as to it's Texture; for it is by no Means ſpiral, or like a Screw; nor do the Seeds grow in that regular Manner, as repreſented in the Figure.

Whatever Uſe may otherwiſe be made of this Diſcovery, a moral one naturally preſents itſelf to us, *viz.* to admire the infinite Wiſdom and Skill of the wonderful Creator: For what thinking Mind can help being ſtruck with Aſtoniſhment, when he conſiders the *Seed-Veſſels* of a coarſe Plant ſo minute as to fly about in the Air like a Vapour, but a little Remove from being inviſible to a naked Eye, framed with ſuch

curious Mechaniſm, containing a great Number of Seeds, too fine to be kenned by the acuteſt Sight without the Help of Glaſſes!

Tooting, Oct. 29, 1741.

Explanation of the Figures.

Fig. 68. A Branch of the Plant.
Fig. 69. The Seed-Veſſels.
Fig. 70. The Seeds.
α α. *A Branch of the Male* Fern.
β β. *Refer to the Leaves, on the Back-ſide whereof, the Excreſcencies, like Jews-Ears, grow, around which grow the Seed-Veſſels.*
c c. *The Stalks of the Seed-Veſſels.*
d. *A Shoot from the Stalk, producing ſometimes another Seed-Veſſel on the ſame Stalk.*
e e. *The ſpringy Chord, embracing the Pod, which contains the Seed.*
f f. *The Pod.*
g. *The Pod with a Crack or Chink in it, to repreſent it's being about to be divided into two Hemiſpheres.*
h h. *The Chord expanded, approaching a right Line.*
i i. *The two Hemiſpheres, when the Pod is divided in two.*
k. *The Seeds.*
l. *Seeds in the Pod, the Membrane being broken and turned up.*

Deptford, Oct. 31, 1743.

Concerning the Seeds of Muſhrooms, by Mr Roger Pickering, *V. D. M.* No. 471. *p.* 593. *Read* Nov. 10, 1743.

XI. 1. I was always of Opinion, that Muſhrooms had their Seeds, as well as others; and attributed the not diſcovering it hitherto, to the Shortneſs of this Plant's Duration, and to it's ſucculent and looſe Contexture, whereby it is liable to immediate Putrefaction from the leaſt Alteration of Weather. I could no otherwiſe account for the Method made uſe of by the *Italians*, who make Muſhroom-Beds in their Cellars, with a Mixture of fine Mould, and the Parings of Muſhrooms laid upon Dung; and that of our Gardeners, who water their Beds with Water, wherein ſuch Parings are ſoaked; but by ſuppoſing, that their Succeſs was owing to minute Seeds lodged and retained in ſuch Parings, and waſhed off by ſuch Infuſions. So alſo, as to the Mouldineſs of old Dung and Thatch, which the Gardeners are very fond of in making their Muſhroom-Beds, I apprehended, that this Mouldineſs was not the nutritive Juice or Salt proper for the Production of this Plant, but the Muſhroom itſelf in it's early and inceptive State. The late warm Rains have enabled me to reduce my Conjectures to a Certainty. In ſhort, I have not only diſcovered, that this Mouldineſs is a Collection of little Muſhrooms adhering to each other by minute Fibres; or, as the Gardeners in other Caſes call them, Runners; but I have had the Happineſs to diſcover and preſerve the Seed of Muſhrooms.

I had prepared for my Obſervations, by ordering the Gardener to make a Muſhroom-Bed, in a well-ſheltered Place, after the uſual Manner; which was finiſhed about ſix Weeks ago, but has not yet worked; and had

had charged him to let me know, if any occaſionally ſprung up in any Part of the Ground. Accordingly, about *Wedneſday*, laſt Week, he informed me, that a great Plenty had appeared above-ground, among the Aſparagus, and on the Graſs-Walks, as indeed I expected, becauſe on *Tueſday* in the Night there had fallen $\frac{10}{32}$ of a Cubic Inch of Rain, which, together with an unuſual Height of the Thermometer, for the Seaſon, made it the moſt ſuitable Weather for Muſhrooms. I immediately choſe out the moſt promiſing Plants, which I covered with Bell-Glaſſes, where there were ſeveral together, and the ſingle Plants with little Hand-Glaſſes, which I had had made for the Preſervation of Wall-Fruit.

Oct. 28, at Noon, I carefully gathered about a Dozen Muſhrooms, of the eſculent Kind, from under the Glaſſes; chooſing ſuch as gradually differed from each other in the Colour of their Gills, from a faint Peach-bloom Colour, to a deep Purple; flattering myſelf, that as I had hereby got the Muſhroom, in it's ſeveral States, ſecured by theſe Glaſſes from the Injury of the Weather, I ſhould be able to diſcover the Seed.

With theſe I gathered ſeveral Muſhrooms of another Kind, commonly known by the Name of *Champignons*; which alſo I had ſecured under Glaſſes. With theſe I began, and ſoon found, what I ſuſpected to be the Caſe, that the Gills, as they are called, are no other than *Capſulæ*, or Pods for the Seed; for with one of the lower Magnifiers, and a fine Penknife, I could eaſily divide them from adhering to each other. This encouraged me to apply directly to the larger Sort of Muſhrooms; and accordingly I fixed upon one of a deep Fleſh-colour, which I looked upon to be, by it's Colour, in it's Prime. I began with one of the Gills carefully ſeparated from the Head, or Stool, without bruiſing; but could diſcover nothing in it like Seeds, except that, here and there, there were ſome globular dark Spots, appearing, through the fifth Magnifier, about the Size of very ſmall Pin-heads: But when I endeavoured, with a fine Bruſh, to wipe off any Thing, to fix it upon a Talck, the lighteſt Touch reduced it to Water. Upon this, I had recourſe to a thin, but tough Filament, which was ſituated upon the Stalk or Stem of the Muſhroom, in an exact Diſtance from the Head of the Muſhroom, and the Mark, which the Earth round about the Stem had made. Upon this Filament appeared a fine downy Subſtance of a lively Brown, reſembling the Down upon a Moth's Wing, but much finer. I could bruſh off ſome of this upon white Paper, without reducing it to Water; but, not having the new Apparatus for opaque Objects, (which is the only one I am without) there was nothing that appeared bold or ſharp enough for me to depend upon. I had then recourſe to a fine Talck in a Slider, and bruſhed off ſome of this brown Duſt upon it; and, after I had applied the ſecond Magnifier, I was gratified with the firſt Sight of the Seed of Muſhrooms; for I then diſcovered a Multitude of round, regular, tranſparent Bodies, bearing the

ſame Appearance as the *Farina* of Flowers. I then applied the higheſt Magnifier, through which they appeared very bold, of the Size of a moderate Pin's Head.

I have endeavoured to draw a Sketch of the Muſhroom, &c. in it's juſt Proportion.

Fig. 73. a. *Is the Muſhroom in which I diſcovered the Seed in it's natural Size.* b. *The Filament upon which the Seed was diſcovered, being, as I apprehend, a wiſe Proviſion of Nature, to prevent the Wind's Power over ſuch minute Bodies as the Seeds are; for, by being placed at an exact Diſtance between the Head of the Muſhroom, and the Ground, it ſecures the Seed before the Wind's Power can affect it, unleſs the Wind be high; and, by another eaſy Fall, enables it to lodge itſelf ſafely in the Ground.* c. *The Part of the Stem under-ground, from which the Fibres ſhoot, upon which the little Muſh-rooms, marked* d, *grow, appearing at firſt but like a white Mould-neſs.*

Fig. 74. a. b. Animalcules *of the Maggot, or Fly-kind, found in the Head and Stems of Muſhrooms in a decaying State.*

Fig. 75. *The Seed of the Muſhroom, as it appears through the firſt Magnifier.*

P. S. I had forgot to mention under the Article *b.* Fig. 73. that the thin Filament is that to which the Edges of the Head of the Muſhroom adhere, while it is, what is commonly called, a Button, and from which it ſeparates by expanding into a Flap.

P. S. Since I wrote the above, I have met with Sig. *Micheli*'s *Nova Genera Plantarum*, wherein I find the Obſervations which I have made upon Muſhrooms, though entered upon without any Hint or Direction from him, or any other Writer, pretty near the ſame with his. I think it therefore a Piece of Juſtice, due to him, and to the Reading and Judgment of Mr *Watſon*, candidly to allow the firſt Diſcovery of the Seeds of Muſhrooms to that *Italian* Botaniſt. It fully ſatisfies my little Ambition to have had the Honour of ſhewing them the firſt to the *Royal Society* of *England*.

N. B. I thought proper to print the Rev. Mr *Pickering*'s Paper on the Seeds of Muſhrooms, together with Mr *Watſon*'s Remarks upon it; becauſe Sig. *Micheli*'s Book, being printed at *Florence*, is not in many Peoples Hands here; and, as that is in *Latin*, I thought it would not be diſagreeable to our Gardeners to have an Account of this Diſcovery in *Engliſh*: Beſides, it is but doing Juſtice to Mr *Pickering*'s Diligence in ſearching into the Works of Nature, ſince he was ſo fortunate as to ſucceed in a Diſcovery which had eluded many curious Botaniſts, and that without having taken any Hint from *Micheli*. *C. M.*

Fig. 67.

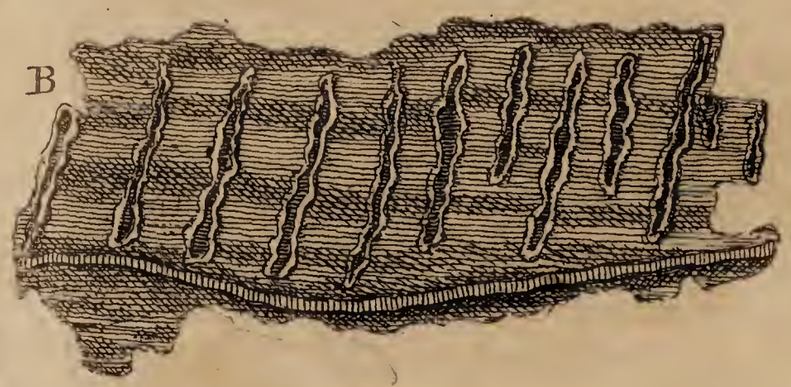


Fig. 72.

Fig. 68.

Fig. 69.

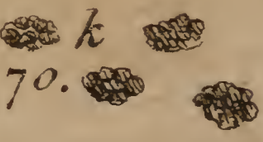


Fig. 70.

Fig. 71.

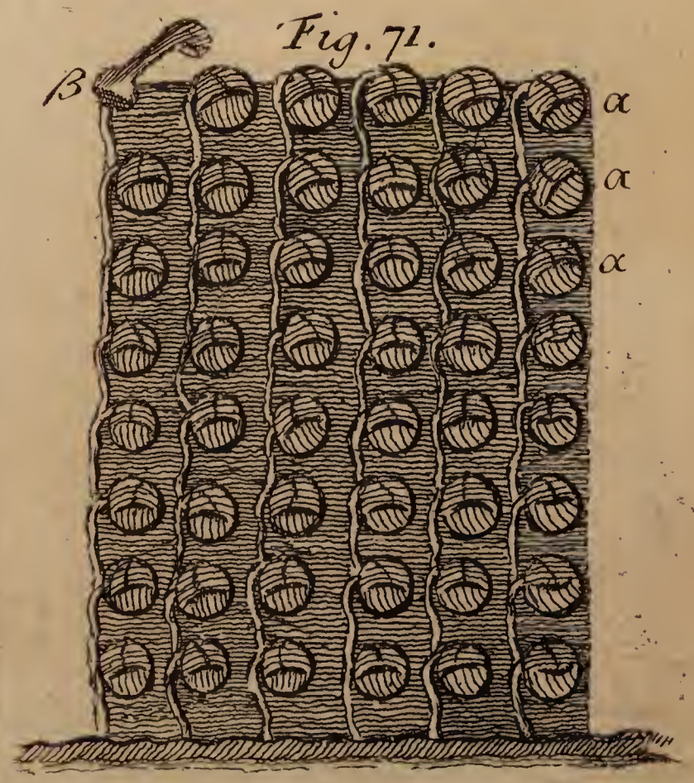
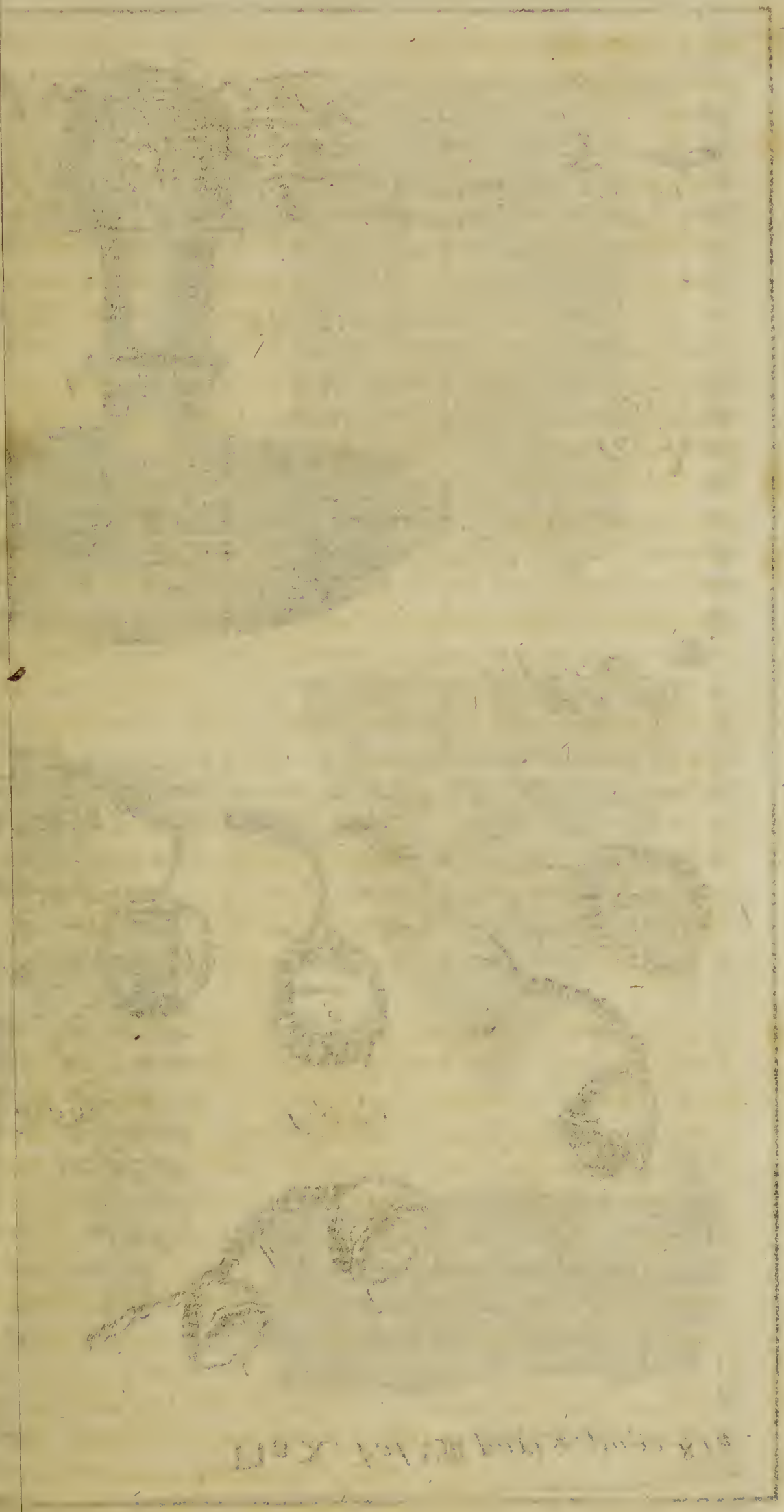


Fig. 73.

Fig. 75.

Fig. 74.



2. Mr *Pickering* having, at your laſt Meeting, laid before you an ingenious Account, and ſhewn you, by the Aſſiſtance of a Microſcope, the Seeds of two Sorts of *Fungus's*, which were imagined, by many preſent, to have been undiſcovered before; I hope I ſhall not be thought to detract from that learned Gentleman's Merit, if I mention the firſt Obſerver of thoſe minute Bodies, although till now they never have, to my Knowledge, been ſhewn in *England*: For, however great my Zeal is to give the Honour of any Diſcovery to my own Countrymen, yet Candour will not permit me to give it them to the Prejudice of thoſe of another Nation. It was to the late Sig. *Micheli*, Profeſſor of Botany at *Florence*, that the World owes the Diſcovery of the Seeds of Muſhrooms, as well as the Flowers and Seeds of the various Species of *Lichen*, or *Liverwort*: He not only ſaw with his Glaſſes, but raiſed from their Seeds, many Kinds of Muſhrooms, as may be ſeen from his Experiments in Page 135 of his incomparable Work, intituled, *Nova Plantarum Genera*, printed at *Florence* in the Year 1729. He conſtantly obſerved the Seeds produce the ſame Species, as in the more perfect Plants.

Some Remarks occaſioned by the preceding Paper, by Mr William Watſon, *Apothecary, and F. R. S.* Ibid. p. 599. *Read* Nov. 17, 1743.

A very worthy and learned Member of this Society, Dr *Haller*, Profeſſor of Phyſick, Botany, *&c.* in the Univerſity of *Gottingen*, in his excellent Work publiſhed laſt Year, intituled, *Enumeratio Methodica Stirpium Helvetiæ*, tells us, when treating of *Fungus's*, Page 34, that their Seeds are produced in the *Laminæ* of their concave Side; as he has moſt evidently ſeen in the 35th, 50th, 73d, 93d, and 107th Species mentioned in his Work; which Seeds are by Nature, when ripe, ſhaken from the Plants, and, being ſown, propagate their Species. He likewiſe mentions, that the Seeds of different Muſhrooms vary in their Colour, ſome being blue, others green, white, *&c.*

That Ornament of this Society, the late Mr *Ray*, indeed, mentions a *Fungus*, diſcovered by his Friend Mr *Doody*, which he calls, in his Hiſtory of Plants, Vol. III. Page 21, *Fungus ſeminifer externè ſtriatus*; and M. *Tournefort*, in his *Inſtitutiones Rei Herbariæ*, Page 560, takes Notice of another Species of this Tribe, which he calls *Fungoides infundibuliforme ſemine fœtum*. M. *Vaillant*, in Page 57, of his *Botanicum Pariſienſe*, gives a Deſcription and Figures of the Seeds of theſe two Kinds. His Words are to this Purport, when tranſlated from the *French*. "Within the Cavity, ſays he, of theſe Plants, towards the "Bottom, are contained many Seeds heaped one upon another, cut "upon their ſuperior Surface ſomewhat like a Triangle, broad under-"neath, where they are connected to a little Tendon, and are whitiſh." Notwithſtanding the high Veneration I have for the Opinions of theſe able Botaniſts, I am ſatisfied the Parts of theſe two Plants, ſo imagined, are not their Seeds, but rather their Suckers, *Stolones*; which, in moſt others of this Tribe, are produced from the Root; but from both theſe, as in many of the Kinds of *Lichen*, and in the *Dentaria bulbifera*, are produced from other Parts of the Plant. I cannot help obſerving, that

in

in almoſt all Plants, whoſe Seeds are produced ſparingly, or are difficult to be ſaved, Nature abundantly makes up that Deficiency by the great Increaſe of their Roots, whereby their Species may eaſily be propagated; as is manifeſt in Muſhrooms, Potatoes, Crocus's, Golden-rods, Starworts, and above all in the *Corona Solis, flore parvo, tuberoſa radice*, of M. *Tournefort*, vulgarly called *Jeruſalem Artichokes*, the Seeds of which, from the Shortneſs of our Summer, having never as yet ripened in *England*. I ſhall only add, that although many Species of Muſhrooms are eatable, and ſome of them better flavoured than the common Sort, the Gardeners only propagate that Sort with red Gills, called, by Way of Excellence, *Champignon*, a Name given by the *French* to all Sorts of Muſhrooms; but ſome deſcriptive Word is added to them, whereby they may be diſtinguiſhed from this. The Method of propagating Muſhrooms according to the uſual Practice, *viz.* from their Suckers, was firſt mentioned by *La Broſſe*, in his Treatiſe *De la Nature des Plantes*, and afterwards by M. *Tournefort* in the Memoirs of the *Academy* of *Sciences*, *Anno* 1707, Page 72.

Nov. 17, 1743.

Microſcopical Obſervations on the Farina *of the red Lily, by Mr.* Turbevil Needham. No. 471. *p.* 639. *Read* Dec. 22, 1743.

XII. Upon viewing an Infuſion of the *Farina Fœcundans* of the *Lilium rubrum flore reflexo* in common Water, I thought I perceived ſome Alteration in ſeveral of theſe minute Bodies, as if the outward Shell or Huſk had, at a ſmall lateral Orifice, ſhed a long Train of Globules adhering to each other, and enveloped in a filmy Subſtance. I, immediately upon this, applied ſome freſh *Farina*, adapted my Microſcope before-hand, with the Tip of my Bruſh dropped a ſmall Globule of Water upon the Object, and in a few Seconds, I plainly perceived a Rope of exceeding ſmall Globules to be ejaculated with ſome Force from within, and contorting itſelf from one Side to the other, throughout the whole Line, during the Time of Action, which does not laſt above a Second or two, and is to be expected from a few only of theſe farinaceous Globules. Theſe emitted Particles are very different from the ſmall Globules of Oil, with which the *Farina* of the Lily abounds; for theſe diffuſe themſelves equally on all Sides, while thoſe, on the contrary, go off in one continued Train, like the ejected Pulp of a roaſting Apple; and are involved in a filmy Subſtance, as the Eggs of ſome aquatick Inſects are. I have ſince choſen the *Farina* of a Pompion to repeat this Experiment upon, which is not of an oily Nature; and, upon account of it's Size, may be conveniently obſerved with the ſecond Magnifier, where I have the Advantage of a larger Field. I viewed ſome few of theſe alſo out of the many farinaceous Globules, which were within the Area of my Microſcope, with the ſame Succeſs, and yet greater Pleaſure: For I could plainly perceive, during the Time of Action, by two or three lucid Specks in the Centre of the Globule, which continually ſhifted their Places, an inteſtine Commotion within the farinaceous Corpuſcle, and a ſtronger Ejaculation of the emitted Particles.

Particles. Mr *Chambers* says in his Dictionary, that no Alteration has been obſerved upon the Infuſion of the *Farina* in Water: But this, I apprehend, is owing to the Obſerver's not being ready with his Microſcope, and preſent at the Time of Action, which is almoſt inſtantaneous; and as the Orifice, at which theſe Particles emerge, is but ſmall, it produces no very ſenſible Alteration in the Globule itſelf.

Paris, Oct. 24, 1736. *N. S.*

XIII. Having, with the Aſſiſtance of the Microſcope, viewed the *Smut* of *Corn*, I obſerved the Stalks were all ſpotted and pricked with ſmall Burnings: Now as the *Smut* happens after a fine Rain, followed by a bright Sun-ſhine, the Cauſe of this Evil is, that the Focus of thoſe very ſmall Drops is juſt near them, and on the Stalk that ſupports them: Wherefore the Sun's Rays, collected in this Point, muſt there burn; which dries up the Stalk, and prevents the Ear from graining.

Concerning the Smut of Corn, by the Abbe Pluche *to Dr* Mortimer, *Sec. R. S. Tranſlated from the* French *by* T. S. *M. D. F. R. S.* No. 456. *p.* 357. Jan. &c. 1740.

The ſecond Remark is on the Corn that grows up into Ears, the Grains of which are for the moſt Part full of Meal, quite black. With the Microſcope I ſaw, all round or above theſe black Grains, ſmall long Bodies, rolled up, and having each a Pedicle; which I found to be the Flowers, that could not reach their due Form, or come forth and ripen; ſo that the Grain, being deprived of this Help, could not develop it's Germ, and produced only a black Meal, for want of the unfolding of certain Veſſels.

The third Remark is, the Reaſon that invites *Thruſhes* or *Starlings* under the Legs of black Cattle grazing in a Paſture. Not being able to get near them, I obſerved them at a Diſtance with a good Glaſs. I ſaw all theſe Birds thruſt their Head and half their Body down into the Graſs, in ſuch Manner that their Tails remained erect in the Air, as that of a *Duck* upon diving; which makes me think, that thoſe Birds ſeek after Worms in the Earth; and that they gather about the Cattle, becauſe as they are large Animals, upon trampling on the Ground, they oblige ſuch Worms to come forth, as happen to be preſſed under the Weight of their Hoofs.

XIV. Upon opening lately the ſmall black Grains of ſmutty Wheat, which they here diſtinguiſh from blighted Corn, the latter affording nothing but a black Duſt, into which the whole Subſtance of the Ear is converted; I perceived a ſoft white fibrous Subſtance, a ſmall Portion of which I placed upon my Object-Plate: It ſeemed to conſiſt wholly of longitudinal Fibres bundled together; and you will be ſurprized, perhaps, that I ſhould ſay, without any the leaſt Sign of Life or Motion. I dropped a Globule of Water upon it, in order to try if the Parts, when ſeparated, might be viewed more conveniently; when, to my great Surprize, theſe imaginary Fibres, as it were, inſtantly ſeparated from each other, took Life, moved irregularly, not with a progreſſive, but twiſting Motion; and continued ſo to do for the Space of 9 or 10 Hours, when I threw them away. I am ſatisfied they are

Microſcopical Obſervations on Worms diſcovered in ſmutty Corn, by Mr Turbevil Needham. No. 471. *p.* 640. *Read* Dec. 22, 1743.

a Species of aquatick Animals, and may be denominated Worms, Eels, or Serpents, which they much reſemble. This, if conſidered, will appear to be ſomething very ſingular: But I have ſince repeated the Experiment ſeveral Times, with the ſame Succeſs, and gratified others with a Sight of it.

Twiford, Aug. 11, 1743.

An Obſervation on the Duplicature of all Skeletons whatſoever, prepared from green Leaves, by Samuel Chriſtian Hollman, *Prof. Log. and Metaph. in the new Univerſity of* Gottingen. No. 461. *p.* 789. Aug. *&c.* 1741.

XV. From the firſt Time of my ſeeing thoſe Skeletons of Leaves, which ſeem to have been firſt prepared by the diligent *Ruyſch*, and thoſe which were prepared by the celebrated Profeſſor *Vater*; I was ſtruck with great Admiration, and a ſtrong Deſire to obtain the Method of performing an Operation, which gives ſo much Light into this ſtupendous Work of the great Creator. I made many Trials on the Power of a ſlow Fermentation and Putrefaction with ſome Succeſs, when I was informed by my learned Friend, that the whole was to be done by Putrefaction, which I afterwards found more fully explained in the *Commercium Liter. Phyſico-Medicum*, printed at *Norimberg*. I now went on ſecurely, and prepared not only Skeletons of ſeveral Leaves, but alſo both Cuticles, which ſtrongly adhere on each Side of every Leaf, and ſeparated them eaſily, and dried them with ſuch Succeſs, as to ſhew all their Dimenſions. Hitherto I had only performed what had been already obſerved and deſcribed in the above-mentioned Papers: But ſoon afterwards an Accident happened, which perhaps has never yet occurred to any of the Diſſectors of Leaves. Whilſt I was buſy in preparing a Leaf, which did not anſwer my Expectation, I threw it away, torn as it was, into a Veſſel that ſtood by to receive what I rejected, and went to work upon ſomething elſe. But ſoon after I had a Fancy to examine the torn Parts of the rejected Leaf by a Microſcope. This Labour proved not to be vain. I diſcovered, not without Wonder, that the Parts, which lie very cloſely one upon another, were now ſeparated by that violent Laceration of the moſt tender Fibres, and were in a moſt diſtinct Manner viſible ſeparately; and ſo that there was a Duplicature to be obſerved of all the *Fibrillæ*, both great and ſmall, of the torn Leaf. I was in Doubt at firſt, whether that violent Laceration had produced any Thing in that Part of the Leaf, contrary to it's natural Conſtitution; and whether this Duplicature of all the *Fibrillæ* was rather owing to the Force applied, than the Work of Nature; but this Doubt ſoon vaniſhed: For after I had tried, in other Skeletons of Leaves which were at Hand, and not yet dried, whether the fine Fibres, of which they are conſtituted, would ſuffer themſelves to be parted without much Force; I found, in Leaves now brought to that State of Putrefaction, that each Cuticle adhered to the Leaf only at the very Edge; and that after the Separation thereof, that Matter of the green Leaf lying under it, being now diſſolved by Putrefaction, went off of it's own Accord. I found alſo, that the Pedicle ſeparated no leſs into two Parts of it's own Accord, and upon taking off the Cuticle,

ticle, began to open; and that upon gently preſſing theſe Parts ſeparately with the Finger, and pulling them gradually aſunder, there was a certain peculiar and ſeparate Net of very ſubtile Fibres annexed to each of them, which very eaſily parts from the other, and has each Divarication, and, as it were, Ramification of Fibres, ſo exactly anſwering to the Divarications of the other Net, and lying ſo cloſely upon them, that they ſeem to make but one Net, before their Separation. When I had ſucceeded thus in ſeveral, I obſerved beſides, in others, which were reduced to mere Skeletons, and afterwards in Leaves which were a long Time macerated in Water, to facilitate the Separation of the ſmalleſt Nets from each other, but chiefly at their very Points, that thoſe Nets parted gradually from each other of their own Accord; and I plainly perceived, that when they were gently moved about in very clear Water, they were actually parted aſunder. I therefore held ſuch a Skeleton with a Finger of one Hand under Water to the Bottom of the Baſon; and endeavoured at the ſame Time, with the other Hand, to raiſe the upper Net, that parted ſpontaneouſly, by Means of a Penknife, till I found I could do it gently with the Fingers; and then I preſſed the under one with another Finger to the Bottom of the Veſſel, holding it faſt there, and ſo endeavoured gently to pull one Net from the other, beginning at the Point of the Leaf. This alſo ſucceeded at laſt, and here I obſerved the ſame Diſtribution of all the Divarications and Diſtributions of both Nets to anſwer exactly to each other.

When I had thus found theſe Nets in every Skeleton to part from each other of their own Accord, I no longer doubted, whether the Force, which I had uſed before, was the Work of Art, or of Nature; and was now ſufficiently convinced, that every Skeleton naturally conſiſts of ſuch a double Net of Fibres. But I was afterwards ſtill more confirmed in my Opinion, when I obſerved by the Microſcrope, that in one Net the Divarication of the Fibres, both great and ſmall, was hollow like a Gutter, and in the other convex, and that in ſuch a Manner, that the Concavities were exactly fitted to the Convexities, and received them ſo accurately, as to reſemble ſimple Fibres, and not to ſhew the leaſt Sign of Duplicature. This is eaſily perceived, in the Leaves I made uſe of, even by a Microſcope of middling Goodneſs. Nor will any one find it difficult to diſcover the ſame, provided he firſt underſtands the Art of making the Skeletons themſelves, and ſuffers the Leaves to come to the juſt Degree of Putrefaction, and performs the whole Operation in a Veſſel not above 6 or 8 Lines deep, and filled with clear Water.

Fig. 76 exhibits a naked Skeleton of a Leaf, prepared by me after the Manner above-mentioned, in which no Diviſion has been attempted. Fig. 76.

Fig. 77 ſhews one partly divided, and after this Separation laid upon the Water in ſuch a Manner, that the Parts of the Pedicle are purpoſely turned a little to the oppoſite Side; that ſo each Divarication of both Fig. 77.

Nets may be ſeen the better, and thus that whole Skeleton is afterward dried. By this it appears very diſtinctly, that every Divarication of one Net is anſwered by juſt as many, and in the ſame Order, in the other, and that not one of them is deſtitute of it's Companion.

Fig. 78. *Fig.* 78 repreſents a Skeleton of a Leaf, divided in ſuch a Manner, beginning from the Pedicle, that one of the Nets may be raiſed as far as they are ſeparated, the other Parts ſtill ſticking cloſe, and ſeeming but one Net, by which the Duplicature is viſible to any one.

Fig. 79. *Fig.* 79 ſhews a Skeleton divided from the Point toward the Pedicle, ſo that each *Lamella* may be ſeparated from the other; but the Parts near the Pedicle are left without any Separation.

Fig. 80. *Fig.* 80 is a Leaf, where one Side only, next the Pedicle, is divided; ſo that one Net may be raiſed from the other, and one Side is left in it's natural State and Situation.

Fig. 81. *Fig.* 81 repreſents not only the Nets ſeparated from each other, but both Cuticles alſo, which are ſo extremely delicate, that the leaſt Puff of Breath will injure them.

Fig. 82. *Fig.* 82 ſhews no Duplicature of the Fibres, but only the Cuticles both of the Leaf and Pedicle, and the Diviſion of the Pedicle into two Parts, to which the Nets cloſely adhere, one being convex, and the other concave.

Some Conjectures on the Uſe of the Duplicature of the Fibres of Leaves, by the ſame. Ibid. *p.* 796.

XVI. I ſuppoſe it generally known by thoſe, who are at all converſant in the Study of Nature, that moſt of the ligneous Fibres in Plants, and ſuch as are analogous to them, conſiſt of many minute *Tubuli* and *Canaliculi*, by which the nutritious Juice is conveyed from the extreme *Fibrillæ* of the Roots to the moſt diſtant Parts, being propelled and protruded by it's moving Principle, whatſoever that is. Whoſoever knows this, can hardly be ignorant, that thoſe ſmalleſt *Fibrillæ*, of which the Stalk or Pedicle of Leaves conſiſts, are only an Elongation and Continuation of thoſe ſmalleſt *Canaliculi*, and conſtitute a peculiar Kind of Bundle of them, by which the nutritious Juice is tranſmitted to the other Parts of the Leaf, and diſtributed through them; and afterwards unfolded by various Divarications and Ramifications through the whole Plane of the Leaf, and recede more and more from each other, but are again wonderfully inoſculated, in many Places, by various *Anaſtomoſes*, and ſo conſtitute together a Kind of coherent Net of *Fibrillæ* and ſmalleſt Tubes. This may eaſily be obſerved by the naked Eye, or by a tolerable Microſcope. Nor can I imagine any one, that is at all verſed in Natural Philoſophy, to be ignorant, that in the laſt Century many very famous Men came into the Opinion, that the nutritious Juice circulates in Plants, as well as in Animals; and that many Experiments have been made to confirm it, before the *Royal Societies* of *London* and *Paris*. Therefore, when I intend to ſpeak of the Duplicature of Leaves, and their ſmalleſt *Fibrillæ*, I look upon this as a Thing commonly known.

Now

Fig. 76.

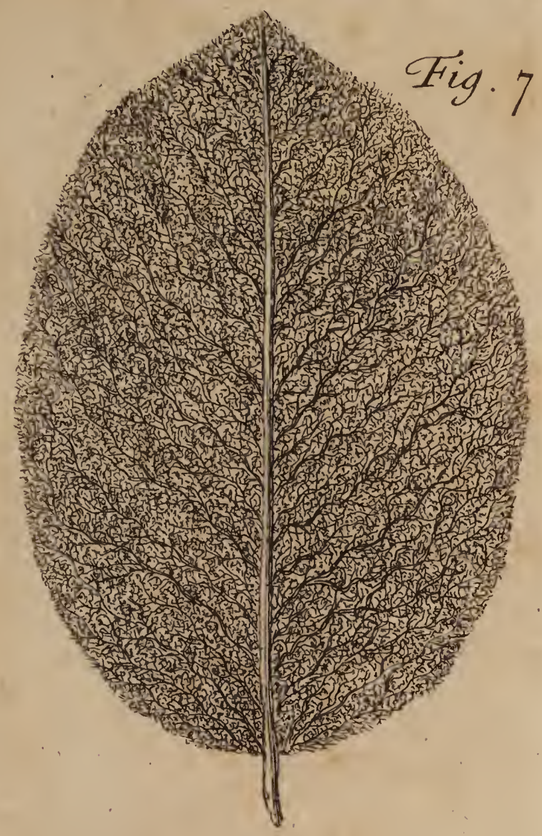


Fig. 77.

Fig. 78.

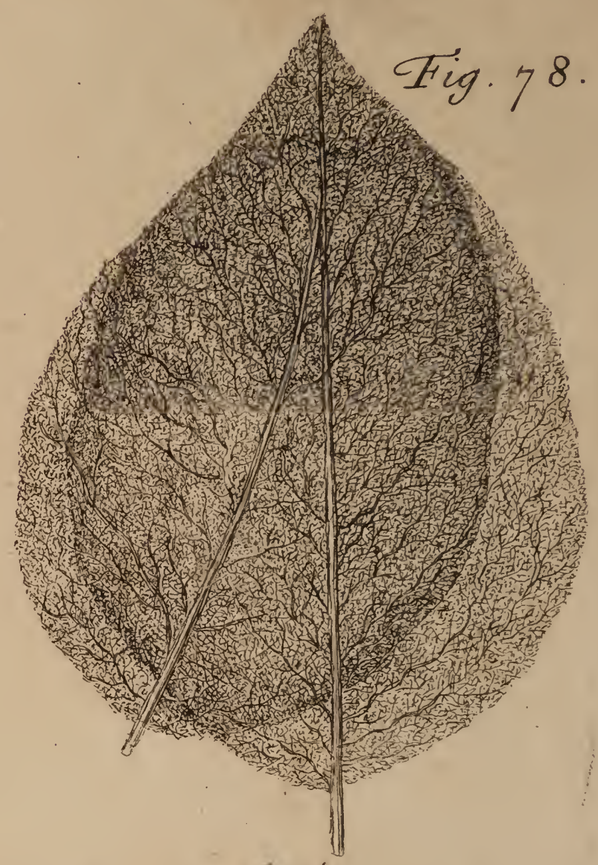


Fig. 79.

Fig. 80.

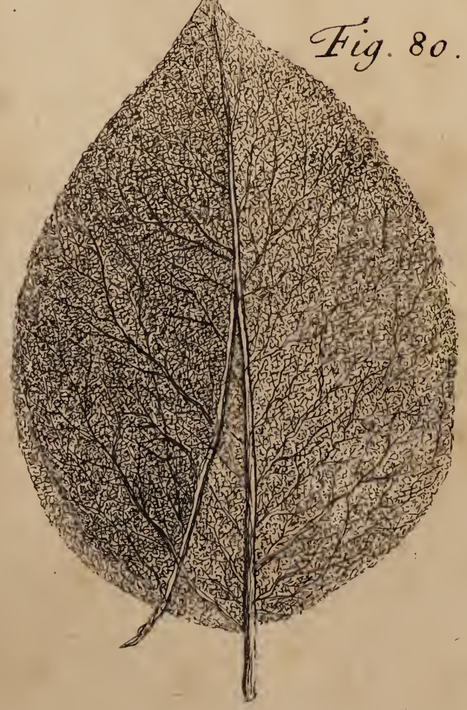


Fig. 81.

Fig. 82.

Now it cannot be imagined, that there ſhould be a ſtronger Argument, to convince thoſe who doubt of the Circulation of the nutritious Juice in Plants, than this Duplicature of the Net-work in all Sorts of Leaves. For if the Fibres of that Net are ſo many little Tubes, by which the nutritious Juice aſcends into the Leaf, and is diſtributed through it, of which hardly any one doubts, and the Duplicature is ſuch as has been already demonſtrated, the very minuteſt having it's Companion exactly correſponding with it; nothing can ſeem more manifeſt, than that one Side performs the Office of Arteries, and the other of Veins. Thus they are always found to accompany one another in animal Bodies; and therefore one Kind of them ſerves to carry the nutritious Juice from the Root to the Extremities, and the other to carry it back from the Extremities to the Root; and thus this circulatory Motion is performed by this different Kind of Tubes in Vegetables.

This is not a Place to inquire, what Truth appears to me to be in this Opinion of the Circulation of the Juice in Plants, much leſs to examine what is ſtill farther to be conſidered about the Experiments that have already been made; which perhaps I may take another Opportunity of doing. But let us ſuppoſe this Circulation to be ſettled paſt all Doubt; yet this Duplicature by me obſerved, does not favour this Opinion quite ſo much as I could wiſh: For in the firſt Place, it does not ſeem evident enough, and paſt all Doubt, that the *Fibrillæ* of every Net conſidered ſeparately, and their Divarications, are Ramifications of the whole *Tubulus*, and of ſo many whole *Tubuli*, ſince in ſuch *Fibrillæ*, cut or broken tranſverſly, no Orifices and Inoſculations of any *Tubuli*, ſuch as are eaſily obſerved in the Fibres of any Sort of Wood, cut tranſverſly or horizontally, could ever yet be diſcovered by me, even with the Aſſiſtance of the beſt Microſcopes. Perhaps therefore, whilſt the convex Part of one Net, is received in the Boſom of the concave one, and ſtrictly embraced thereby, ſome ſmall and only inſenſible Cavity is left between them, which ſerves to tranſmit the nutritious Juice; and thus the Divarications of both Nets being mutually conjoined, perform the Office of *Tubuli*. But if, notwithſtanding what has been ſaid, we ſhould grant, that all the *Fibrillæ* of both Nets are ſo many entire and perfect *Tubuli*, by each of which any nutritious Juice is tranſmitted, and diſtributed through the Subſtance of the whole Leaf; yet I do not think, that it can hence be inferred, that the *Tubuli* of one Net perform the Office of Arteries, and thoſe of the other that of Veins, and ſo that the nutritious Juice is circulated in theſe *Tubuli* of the Nets: For I have obſerved two Things principally in the above-deſcribed Preparation of Leaves, which do not ſeem at all to favour this Opinion. 1. I have diſcovered, that the ſmalleſt *Fibrillæ* of both Nets, ſeated and terminated in the extreme Edge of the Leaf, can much more eaſily be ſeparated from each other, and recede, as it were, of their own Accord, than thoſe which are more remote from the Edge; though each Cuticle adheres moſt cloſely on each Side at the Edge; and though it

has already receded of it's own Accord, from both Nets of the Leaf, through it's whole Circumference; yet here it muſt be carefully diſſected with a Knife, if we would have one *Lamella* depart from the other: Which ſeems to be a moſt evident Argument, that the Extremities of the *Fibrillæ* of both Nets do not cohere at the Edge of the Leaf, and bend like Arteries to their Veins, ſince thoſe moſt ſubtile Tubes ought moſt ſtrictly to cohere, eſpecially in this Place. 2. This alſo is worthy of Obſervation, which I have found not ſeldom to happen; that when one Surface of a Leaf ſwimming upon the Water, during the Time of Putrefaction, has riſen a little out of the Water, this very Surface being leſs thruſt under the Water than the other, and being all covered with Putrefaction, has been made fit for the Preparation of a Skeleton, it has with more Difficulty let go it's Cuticle, and ſuffered the greeniſh Parts, placed between the *Lacunæ* of the Net, to be waſhed off by the Water, than the other Surface of the ſame Leaf. When this therefore has happened, I have ſometimes obſerved by the Microſcope, that the lower Net of the ſame Leaf, with regard to the Situation and State of Putrefaction, has been deprived of all the green Pulp, ſticking between it's Divarications and *Lacunæ*, whilſt it was cloſely fixed and interwoven between the Divarications and *Lacunæ* of the lower Net; which may eaſily be obſerved by any one, who will apply himſelf to this Subject. Since therefore it is thus evident, that this ſubtile green Pulp, which lies cloſe under each Cuticle of every Leaf, and generally comes in great Part away of it's own Accord, after due Putrefaction is no leſs diſtinguiſhed into two *Lamellæ*, and as many *Strata*, of which one intimately and cloſely interwoven with the one, and the other with the other Net of the Leaf; it ſeems alſo to be very evident, that one Net ſerves to generate one Surface of the Leaf, and the other to do the ſame to the other.

Since therefore the Uſe of that Duplicature in the Skeletons of all Leaves is manifeſt, let me add ſome other Things belonging to this Argument, the firſt of which chiefly concerns the Generation of that greeniſh Pulp, which lies on each Side between the *Lacunæ* of both Nets. It is manifeſt to me, from ſeveral Obſervations and Experiments, that it is produced from the nutritious Juice in Vegetables, that being concreted, it acquires the Form of Bladders; whence it has been deſcribed under the Name of *Utriculi* by good Writers. It appears from the Pith of all Trees, from their green Bark, from the Stalks of moſt Flowers that riſe immediately from the Ground, from thoſe which are protruded from Trees, and from the other common Leaves of all Plants whatſoever, in which the utricular and veſicular Figure may generally be ſeen by the naked Eye. Now it is manifeſt from Experience, that when any viſcid Liquor, or ſuch as is impregnated with ſaline and oily Parts, is driven through narrow Tubes by an Agitation of the Air, it is always expanded into fewer or more Bladders at the Extremities of thoſe Tubes, which is known even by our Childrens playing

ing with the Soap-ſuds. But ſince it appears from the Anatomy of Plants, that their ſolid Parts and Fibres commonly conſtitute their ſmalleſt *Tubuli* and *Canaliculi*, which run from the *Fibrillæ* of the Root to the utmoſt Ends of the Leaves in the more perfect Plants; and as it is no leſs manifeſt, that the nutritious Juice is propelled to the Ends of the Leaves, by no other Force than that of the Gravity and elaſtick Power of the Air incumbent on the *Fibrillæ* of the Roots; it is very probable, that the nutritious Juice, being propelled by the Power of the Air through the moſt narrow *Tubuli* of Plants, to their very Extremities, is expanded into ſome very ſmall Bladders, and after the inſenſible Tranſpiration of the aqueous Parts conſolidates, and retains that veſicular Form, and that ſo this veſicular and utricular Subſtance is formed in Plants. From this moſt ſimple Theory, in my Opinion, may almoſt all the *Phænomena* relating to the Nutrition of Plants, as well as thoſe which have already been obſerved by the learned and judicious Dr *Hales* receive ſome Light, as I ſhall prove more fully at another Time. By theſe Means it ſeems to me, that the green, and the veſicular and utricular Subſtance in Leaves, may exude from the ſmalleſt *Tubuli* of every Net, and their Extremities, and adhere to thoſe ſmalleſt *Tubuli*, and there be gradually hardened between the Cuticles, and ſo with thoſe *Tubuli*, from which it is protruded, and in a Manner interwoven with their *Lacunæ*, form at laſt a common and continuous Expanſe in the Net of every Leaf. But the Cauſe of the Divarication of the *Tubuli* from each other, cannot at preſent be explained at large, though it might be underſtood from the ſame Fundamentals. But becauſe that green Pulp is of a far more tender and ſoft Subſtance than the *Tubuli* of the Nets; it is more eaſily deſtroyed alſo by Putrefaction, whilſt the *Tubuli* of the Nets remain yet entire, and unhurt by that Putrefaction, and may be diſtinctly perceived to be entirely denudated.

This Obſervation furniſhes me with another, not unworthy to be mentioned. The figured Stones, which repreſent the Figures of various Plants, even of ſuch as are exotick, with all their Ramifications, which are the moſt tender and ſubtile of any Thing in Nature, have cauſed me to doubt, whence their Figures could ariſe in thoſe Stones. Great Quantities of Stones are digged up in the Mountains about *Gottingen*, for building Houſes, and paving the Streets, which beſides petrified Shells, Sea-Stars, *Cornua Ammonis*, and ſuch like, between the Joints of the Shells, nay, and upon the very petrified Shells themſelves, have Delineations of Shrubs ſo fine, that the naked Eye cannot diſcover all their Parts; and it may well be queſtioned, whether any Plant in the World has ſuch delicate Branches. But after the Preparation of thoſe Skeletons, and the making of that Obſervation, that the green Pulp is more eaſily corrupted than the *Tubuli* of the Nets, the whole Doubt vaniſhed. For thoſe delicate Shrubs, delineated in Stones or petrified Bodies, ſeem to be only the Nets of Leaves remaining after the Putrefaction of the other Parts, and imprinting their Form on the

ſoft Maſs, which afterwards is hardened to Stone. This Opinion will appear probable to any one, who will take the Trouble of comparing the Net-work of Leaves and theſe Shrubs together.

Concerning the Vegetation of Melon-Seeds 42 Years old, by Martin Triewald, *F. R. S. Captain of Mechanicks, and Military Architect to the King of* Sweden. No. 464. *p.* 115. *Read* May 20, 1742.

XVII. Secretary *Hæreus*, of this Place, having a large Collection of natural Curioſities, amongſt which he has likewiſe collected a great Number of foreign Seeds, and finding he had *Melon-Seeds* that were laid up in a Paper in the Year 1700. I was curious to try if they had retained their vegetative Quality, and accordingly the 21ſt of *Feb.* laſt, I planted myſelf 24 of them in a ſeparate Hot-bed, of which I had 21 good Plants, which, after they were planted in a new-made Hot-bed, ſhewed Flowers before they began to branch themſelves, and their Branches were very narrow, yet produced early and plenty of good *Melons*. This Experiment ſhews not only how long *Melon-Seeds* retain their vegetative Quality, but likewiſe that good *Melon-Seeds* cannot well be too old. I know it is no new Thing to make uſe of old *Melon-Seeds* rather than new, but I never heard of any Body trying ſo old as theſe.

Stockholm, Nov. 16, 1741.

Concerning the wonderful Increaſe of the Seeds of Plants, e. g. *of the Upright Mallow, by Mr* Joſeph Hobſon. No. 468. *p.* 320. *Read* Jan. 27, 1742-3.

XVIII. Obſerving here a large Plant of the common *Upright Mallow*, which I thought muſt have a large Number of Seeds, I had the Curioſity to count them. The Seeds being diſpoſed in Rings, I counted thoſe which were upon the principal Stems, and there were upon

The	First.	Rings.
	1	1100.
	2	1058.
	3	888.
	4	874.
	5	753.
	6	744.
	7	732.
	8	587.
	9	466.
	10	465.
	11	378.
	12	355.
	13	344.
	14	341.
	15	210.
	16	180.
Upon many odd ſmall Stems		724.
Rings in all		10199.
Multiply by Seeds in one Ring		12 Seeds.
Number of Seeds		122388.
Allow for two large Stems deſtroyed		7612.
Seeds in all		130000.

I then

I then counted the Seeds in several particular Rings, and found them commonly 14 in each, but have confined myself to multiply the Rings by 12, which is moderate, yet makes the Number of Seeds amount to 150000, allowing 7612 Seeds for two large Stems cut down and destroyed, a moderate Allowance, considering two of the Stems alone contain each above 1000 Rings: Some of these Stems were above 2 ½ Yards high. I have to add, that this Plant was a Seedling last Year, transplanted out of the Fields on the End of a sloping Strawberry-Bed; and I counted the Rings in the Middle of last *July*, when it had Thousands of Flowers upon it, which, with Thousands that must still succeed, might very probably produce more than 50000 Seeds * more, considering 1000 Rings contain 12000 Seeds and more; and if we multiply the Number of Rings actually counted, by 14, the Number of Seeds contained in one Ring, instead of 12, we shall have an Addition of 20000 Seeds; all which, added together, amount to 200000, the possible Increase of one Seed.

Macclesfield, Sept. 1, 1742.

XIX. About 3 Years since, seeing some *Bulbous Roots* set in Glasses filled with Water in a Shop Window, and being told they would flower in that Manner, I immediately tried a couple of *Hyacinths*, which blowed very prettily the next Spring: It pleased me much to see that we could have such Things in a close Room in Town, without the Help of a Garden to produce them, having lately come out of the Country, and being a Lover of Flowers; wherefore I began to think if I could contrive a Method to make a Pot-full blow together, with a Mixture of several Sorts of Flowers with a Variety of Colours, it would be an Improvement.

Experiments and Observations on Bulbous Roots, Plants, and Seeds growing in Water, by Mr William Curteis. No. 432. *p.* 267. April, *&c.* 1734.

The next Year, I took a couple of common penny Garden Pots, and stopped the Holes at the Bottoms with Corks; and painted the Pots, and puttied the Corks, that no Water could filtrate through them; then had a couple of Boards cut to fit the Tops of the Pots, bored with seven Holes at equal Distances, to place my Bulbs in, and likewise as many small Holes for placing of Sticks, to tie the Stems of the Flowers to; I then planted *Hyacinths*, *Narcissus's*, *Tulips*, and *Junquils*, and filled the Pots with Water up to the Board, so that the Bulbs stood only upon the Water, where they blowed very well, and made the best Appearance, as I thought, I had ever seen, beyond any Flower-Pot that could be dressed by gathered Flowers. After the Bloom was over, their Leaves looking green, I set them out in my little Garden, thinking any Thing that looked green, and made a tolerable Figure, agreeable in a *London* Garden; and not depending on the Bulbs again to be of any Service to be preserved, I let them stand till toward Midsummer, and took no farther Care, but now and then giving them fresh Water as it

* Even supposing many of the Flowers to produce no Seed.

perſpired or evaporated, and when the Rains filled the Pots, I emptied them down to the Boards again; but the Bulbs ſhrinking, ſome of them ſlipped through the Holes down to the Bottom of the Pot, and about Midſummer, when their Leaves began to grow yellow, I went with a Deſign to pull them up and throw them away, I was ſurprized to find that the Bulbs, which were buried in the Water, were grown firm, and too large to be drawn back through the Holes, being ſound and fit for blowing the next Year, and increaſed in Off-ſets.

This occaſioned me the next Year (which was the laſt) to try another Experiment of blowing my Bulbs under Water, which I found anſwered beyond what could be expected, for they rather out-do thoſe that grow in the Ground, in the Strength of their Stalks, the Clearneſs of their Bloſſoms, the laſting of their Bloom, and likewiſe the Difference of their Seaſons, which may be ſo managed, according to the Warmth of the Rooms they are kept in, as to have the ſame Sorts in Flower from *Chriſtmas*, till the natural Time of their Bloom in the open Ground, which is *March* and *April*.

But finding it very troubleſome to keep the Boards fixed under Water, I thought Lead might anſwer the Purpoſe better; whereupon, I got ſome Sheet Lead, of about four Pounds to the Foot, cut fit to my Pot, and made Holes in it proportionable to the Bottoms of my Bulbs, and likewiſe ſmall Holes to fix Sticks for the Support of the Leaves and Stems of the Flowers; I put a little coarſe Sand in the Bottoms of my Pots, thinking it would ſupport the Sticks, and keep them ſteady; but when I came to make uſe of the Sticks, the Sand gave way; I then made falſe Bottoms with Lead, and cut Holes oppoſite to thoſe at the Top, which anſwered my Purpoſe. Upon taking up the Bulbs to put in theſe falſe Bottoms, I found the Sand had corroded the Fibres, and changed them all like Ironmould, that I thought they were ſpoiled; but rincing them in two or three Waters, it came clear off, and on fixing my falſe Bottoms, and placing the Bulbs in their Holes, and filling them up with freſh Water, they recovered, and never changed again in the clear Water, but thrived and put forth their Flowers very kindly, although by the Experiments which I had tried, before I could fix them right, I had often planted and tranſplanted them. But I found afterwards, that Glaſs Jarrs of the Form as repreſented in the Plate, were the moſt convenient, both for ſeeing the Progreſs the Roots made, and for knowing when they want to be cleaned.

Fig. 83. At *Fig.* 83 is repreſented one of theſe Glaſs Jarrs, containing the following Flowers.

1. Golden Sun,
2. Boſſelman,

} *Narciſſus*'s.

3. Keyſers Jewel,
4. Pulchra,
5. Janus,

} *Hyacinths.*

At

At *Fig.* 84 is represented the Profile or Section of the same Jarr. Fig. 84. *a.* The Sticks to tie up the Leaves and Stems of the Flowers. *b.* The upper Lead with Holes to support the *Bulbs* and Sticks. *c.* The under Lead with Holes to support the Sticks steady.

By several Experiments on dried Bulbs, and those that were taken fresh out of the Ground, I find the dried ones do best; for those taken growing out of the Ground, being full of Moisture, will not so soon, upon changing their Element, be acquainted with a new one; the Fibres they had struck in the Ground, always rot, and they must make new ones in the Water, which makes them require a long Time before they can recover themselves enough to flower. The Bulbs will not rot, yet they will not be so strong as those put in the Water when dry, which fill themselves with Moisture by Degrees: Therefore, when I plant my Bulbs, I set them at first on the Top of the Water; for I found by two or three Experiments, that those planted under Water did not push out their Fibres so soon, nor so strong, as those set upon the Water; the Reason of which I take to be, that they were filled with Water too soon, whereas those set upon Water attracted it by Degrees, and so made both the Fibres and the Bulbs grow stronger; and then about 5 or 6 Weeks after planting them, as the Fibres push out, I by Degrees fill the Water higher and higher, till the whole Bulb is covered, and so keep them till the Bloom is over, and the Season for drying them returns.

One Observation surprized me, *viz.* two of my *Hyacinths* were mouldy, which Mould cankered and eat Holes through several of their Coats or Scales; this I picked and cleaned several Times, but still it spread farther and farther; but soon after they were covered with Water, I could perceive them heal by Degrees, till they became perfectly sound, and blew their Flowers as kindly, as those that had continued perfectly sound.

By another Experiment, I tried what Bulbs would do if kept all the Year under Water: I left in Water a *Narcissus*, an *Hyacinth* of *Peru*, and several *Junquils*, that were planted in *October*, 1732; which are now as sound and strong, as those I took out and dried, and promised fair for a Bloom; I observed that their old Fibres did not rot, till they were ready to push out new ones.

Another Observation seems worthy of Notice; one of my double *Hyacinths*, commonly called *Keyser's Jewel*, brought two Pods of Seed to Maturity; which I have blowed for 14 or 15 Years successively in the Ground, and could never find them make any Thing towards seeding; and I have reason to think that several other Bulbs would have seeded, if I had taken timely Care of them, but did not perceive it till too late.

Mr *Miller* intimates *, that Bulbs ſet in Glaſſes grow weaker, and ſhould be renewed every Year with freſh ones; but I obſerved by this Way of raiſing them under Water, that at their taking up, they are as large, and ſome of them ſtronger than when they were planted, and if they be dried at the proper Seaſon, will produce a ſecond Year as well as freſh ones.

I planted likewiſe *Ranunculus* and *Anemone Roots*, which grew and ſhot up the Stems of their Flowers very ſtrong, but the Buds of the Flowers were blaſted, which I am apt to think happened from their being crowded too much, having no Convenience to give them free Air enough.

I alſo planted *Auriculas* and *Pinks*, the *Pinks* flowered, but the *Auriculas* were not ſtrong enough; they are ſtill both of them growing, and I am in Expectation they will blow the next Seaſon.

I have tried alſo ſeveral Shrubs, as *Roſes*, *Jaſmines*, and *Honeyſuckles*; which all grew, and ſtruck out freſh Fibres, and the *Roſe-Tree* made ſix ſtrong Buds for Bloſſoms, but accidentally ſetting them out in a hot Sun-ſhiny Day in *April*, they were all ſcorched up, that they came to nothing; I obſerved, that ſtrong Suckers cut off 2 or 3 Inches under-ground, without any Fibres, grew the beſt.

By another Experiment, I was willing to try what the ſucculent Plants would do in this Way; I took a Leaf of the *Opuntia*, or *Indian Fig*, and laid it by to dry for 3 Weeks or a Month, till it had loſt all it's Moiſture, and was nothing but a dried Skin; I then planted it in Water in the beginning of *July*, and tied it to a Stick that was fixed in one of my Leads, and filled the Pot ſo, that the Bottom of the Leaf was $\frac{1}{4}$ of an Inch in the Water; in about a Month's Time the Leaf filled, ſtruck out Fibres, and put forth a freſh Leaf, which is now growing, and has made as much Progreſs as ſuch a Plant would do in the Earth, in the ſame Space of Time: I had no Opportunity of trying other ſucculent Plants.

Dr *Mortimer* told me he had placed Beans upon Water, which bloſſomed and podded: This put me upon trying the Experiment with them, and likewiſe Peaſe at the ſame Time. I planted 6 Beans in a Pot, and fixed Sticks in it to ſupport their Stems as they grew; they bloomed as freely as thoſe which are planted in the Ground, but did not pod ſo well, having not above a Pod or two on each Plant, which came to Perfection, and ripened their Seed; but this might happen for want of a little more Experience; the Peaſe which were of the dwarf Sort, drew a little too much, and only put out three or four Bloſſoms at the Extremity of their Tops, but every Bloſſom brought a Peaſe-cod, and ripened it's Seed.

This Growth of the Beans and Peaſe made me imagine, that other Seeds would ſucceed in the ſame Manner, knowing they would chip

* See Vol. VI. Part ii. Chap. 5. §. xxi. 2.

upon

upon being laid for a little Time in Water, or in a moiſt Place: The only Difficulty was to invent ſomething proper for their Support in growing. The firſt Thing I tried, was boring very little Holes in a Piece of Lead, fixed in a Pot, and ſowing the Seeds thereon; I found they would ſprout, but as the Water evaporated, filling in freſh moved the Seeds from their Places, that they could not fix themſelves to turn their Radicle down into the Water; I then tried Towe or Hemp, and ſpread it on the Lead, which I found anſwer the Purpoſe of ſupporting the Seed, which by that Means grew, and the Radicle taking hold of the Towe, it was enabled to throw up it's Plume or Shoot; I then tried ſeveral Sorts of ſmall Seeds, and found they would all grow, though I made the Experiment about *Chriſtmas*; but I found the Towe diſcoloured the Water, and gave an offenſive Smell, and that the Seed did not thrive kindly: I then tried Wool and Cotton, the Cotton being too boyant, would not ſo well anſwer the Purpoſe; but Wool, when it is juſt buried in Water, being like a Gelly, and not drying ſo ſoon on the Top, even though the Water has left it, entirely anſwers the Purpoſe as well as ſowing them in the Earth; and if the Seed be good, will keep clean for 2 or 3 Months; for this Way of ſowing will diſcover whether the Seed be mixed with old Seed (as thoſe bought at a Seed-Shop generally are). I ſowed ſeveral Sorts of Sallad-Seeds in this Way, and they came to as great Perfection as thoſe of the ſame Kind raiſed in Hot-beds: And thus they may be produced in any Room or Garret, early in the Spring, and ſo on till late in Autumn, till the cold Weather comes in, and afterwards in the Middle of Winter, in a Room where a conſtant Fire is kept. I had ſeveral Sallads laſt Spring, and this Autumn, by ſowing different Sorts every Week one under another, in ſmall Half-penny Pots; as *Lettice*, *Creſſes*, *White Muſtard*, *Rape*, and *Raddiſh*, which in a Fortnight after ſowing would be fit to cut; ſo that keeping a proper Succeſſion, I had every Week a tolerable Sallad for two or three Perſons.

My Way of ſowing of theſe Seeds, is to have a Piece of Lead bored full of Holes, and made to fit the Pot, about half an Inch below the Top; then filling it with Water, I take a little clean Wool, and ſpread it even and thin, upon the Surface of the Lead, quite home to the Sides of the Pot, which will then look like a Gelly; if there is too much Water, I pour it off, till the Wool only appears covered or filled with Water; then I ſow the Seed pretty thick, and in 48 Hours it will begin to chip, and in a Fortnight after ſowing, will be fit to cut for a Sallad.

I obſerved from ſeveral Experiments, that any of theſe Plants tranſplanted out of the Earth into Water would not thrive kindly; but thoſe raiſed in Water may be tranſplanted into Earth, ſo that this Method of raiſing Seeds in Water may be of uſe in a dry Seaſon, to be pricked out into the Earth, though they will not come up in ſuch a Seaſon, if

ſowed in the Ground, yet tranſplanted from Water they will take as freely to the Earth as if raiſed in it.

I dō not know but from the foregoing Experiments in Water, we may come at a better Way of planting in the Earth, eſpecially ſome Roots, which are apt to rot in the Ground, as *Anemones*, *Ranunculus*, and *Hyacinths*; from an Obſervation I have frequently made, but never before took Notice enough to improve it, which is, that I have often ſeen a Bulb dropped by Chance upon the Ground, ſtrike out Fibres ſtronger and more numerous than thoſe planted in their uſual Depth of Earth would do. The Uſe I would make of this Obſervation, is, that when I plant my Bulbs, I take out the Earth of the Bed, I deſign to plant, as deep as the Bulbs or Roots are to ſtand when planted, and place my Bulbs on the Surface, till the Moiſture of the Earth ſhall have attracted their Fibres, and they begin to ſhoot up their Plume, and then by Degrees I cover them over to the Thickneſs of Mould, that they ſhould ſtand in, by which Means they will be in no Danger of rotting after they have got ſtrong Fibres; for when we plant theſe Bulbs or Roots, it is generally either too wet, or too dry; if it be a wet Seaſon, the Bulbs are too ſoon ſaturated with Moiſture, which rots them; and if it be too dry, they lie ſo long, before they can attract Moiſture enough to make them vegetate, that they grow mouldy, and are rendered dry and hard as a Piece of Stick, ſo that the firſt Rain infallibly rots them.

N. B. Theſe Experiments were made without the Benefit of any Sun, all my Windows having a *Northern* Expoſition.

As theſe Experiments have opened a new Scene of Knowledge in the vegetable World, and may be of great Uſe in Natural Philoſophy, and particularly improve the Art of Gardening; 'tis to be hoped the Curious will carry on the Inquiry as they have Leiſure and Opportunity.

Directions for planting Bulbous Roots in Pots or Glaſſes of Water.

When the Leaden falſe Bottoms are fixed down tight, within 2 or 3 Inches from the Bottom of the Pots (which is only deſigned to hold the Sticks ſteady that are to ſupport the Leaves and Stems of the Flowers) lay on the Lead, which is to ſupport the Bulbs, placing the notched Part oppoſite to that in the falſe Bottom, as near as the Sticks when placed will ſuffer it; then place your Bulbs in each Hole, and fill in Water up to the Lead, which will then touch the Bottom of the Bulb, and as the Water evaporates or perſpires, keep it filled to that Height, till the Bulbs have ſtruck their Fibres pretty ſtrong into the Water, which may be in a Month or 6 Weeks; then fill in Water about ½ an Inch above the Lead, and by Degrees as the Fibres ſtrengthen, and the Plume or Head ſprouts, fill it higher and higher till the Bulbs be entirely buried under Water, which muſt be continued till the Seaſon for drying them returns.

But you muſt obſerve at the planting the Bulbs to clean them very well from any Foulneſs they may have at their Bottoms, by ſcraping

them with the Point of a Knife, till the ſound Part of the Bulb appears, and likewiſe clear them of all their looſe Skins, and even the brown Skin, till they appear white; which otherwiſe will diſcolour and foul the Water that ſhould be kept as clear as poſſible; and for this Reaſon, the Notches in both the Leads are contrived, that upon ſhifting all the Water out of the Pots, if there happens to be any Sediment, by ſhaking the Pots once or twice as it is poured off, all the Foulneſs may come with it; but this ſhifting of the Water need not be done but once or twice in a Winter, or whenever you ſee Occaſion by the Diſcolouring or Foulneſs of it; and at the ſame Time it will be neceſſary with a Painter's Bruſh to clean off all Slimineſs that will adhere to the Sides of the Pots and Bulbs, and rince them well, by pouring Water on them at a little Diſtance: By this Method they may be kept perfectly clean; at any Time when the outward Skins of the Bulbs looſen and begin to decay, clear them off, which otherwiſe would occaſion Foulneſs; and whenever you ſee Duſt ſwimming on the Surface of the Water, fill the Pot full, and let it run over, which will carry it all off, and then pour off the Water to it's uſual Height.

N. B. Plant Bulbs of equal Bigneſs, at leaſt in Height, together in the ſame Pot, that they may have the ſame Benefit of the Water; therefore I plant *Narciſſus* and *Hyacinths* and Bulbs of that Size together; *Tulips* and *Junquils*, &c. by themſelves; and *Crocus* and *Snow-drops*, &c. by themſelves.

Bangor-Court, Shoe-Lane,
Decemb. 19, 1733.

Bury St Edmund's, Nov. 1, 1738.

Concerning the Virtues of the Star of the Earth, Coronopus, *or Buckshorn Plantain, in the Cure of the Bite of the mad Dog, by Mr* Thomas Steward, *V. D. M.* No. 451. *p.* 449. Dec. 1738.

XX. Having met with a Paragraph in the Hiſtory of the Works of the Learned for *July* laſt, in which the Author takes Notice of a Paſſage in the *Philoſ. Tranſ.* *, relating to ſome Vegetables ſaid to have great Virtue for the Prevention of that terribly Malady called the *Hydrophobia*, *viz.* the *Lichen cinereus terreſtris*, and an Herb called, *Stellaria*, or *Star of the Earth*; as to the latter of which, at leaſt, I apprehend there muſt have been a Miſtake, though an involuntary and unavoidable one, through the Defect or Confuſion of the Memoirs made uſe of. I have endeavoured to get ſome further Light into the Affair, by a Converſation with Dr *S. Dale* of *Braintree*, who fully concurs with me in his Sentiments, as to the Subject of this Letter. In his well-furniſhed Botanick Library, I met with ſeveral Things which are *Deſiderata* in my own much meaner one, that greatly contributed towards the Elucidation of what has been ſtrangely obſcured by an odd and unaccountable Complication or Accumulation of Miſtakes, grounded upon Narratives in which there ſeem to me to be diverſe Inconſiſtencies, and Miſrepre-

* See Vol. IX. Part iii. Chap. 5. §. xiii. 1.

ſentations

ſentations of Matters of Fact, through Inadvertency or Lapſe of Memory, or Anachroniſms, by which my once very dear Friend and kind Correſpondent, Mr *Ray*, (whoſe Name and Memory muſt ever be precious to all Lovers of ſolid Learning) was himſelf led into a Miſtake (and became the innocent Occaſion of leading others into the ſame) about the laſt-mentioned Vegetable, which he took to be *the Star of the Earth*, mentioned by *Grey*, as a ſovereign Remedy againſt the Bite of a mad Dog; but was afterwards convinced, that it was not ſo, as will evidently appear from what follows, in which I have done what in me lies to get to the Bottom of the Matter, and to extricate it out of that Maze in which it has pretty long lain hid, by the Help of the beſt Clue that I could poſſibly find.

Having made the Study of Botany the agreeable Amuſement of my younger Years, I was very much puzzled with what I met with in the Appendix to the 2d Volume of the general Hiſtory of Plants, compiled by the reverend and learned Gentleman but now mentioned, concerning the *Spaniſh Catch-fly*, which he there affirms (*p.* 1895.) to be *the Star of the Earth*, ſo famous for the Prevention of the *Hydrophobia*; whereas I always (before I read this Aſſertion in Mr *Ray*) took the *Coronopus*, or *Bucks-horn Plantain*, to be the true *Star of the Earth*, and do ſtill believe it ſo to be, for the Reaſons that will occur to you in the Sequel.

Being deſirous to know what Grounds Mr *Ray* had for aſcribing ſuch Virtue to the *Catch-fly*, I wrote a Letter to him, dated ſo long ago as *Dec.* 1, 1698, in which I requeſted of him to tell me what his Sentiments were at that Time upon this Subject. My Words were theſe, *viz.*

" I deſire to know your Opinion concerning that Herb, which *Grey*
" calls *Star of the Earth*, and affirms to be very efficacious for the Bite
" of a mad Dog. There ſeem to be 2 Plants mentioned under this
" Name, *viz. Plantago foliis laciniatis*, *Coronopus dicta*, and *Lychnis*
" *viſcoſa flore muſcoſo*, *ſive Seſamoides Salamanticum magnum.* The firſt is
" highly eſteemed in *Norfolk*, and is commonly uſed with good Succeſs.
" The latter is known but by few, and I have never known any that
" have uſed it. But in your *Appendix* to your general Hiſtory, you
" affirm on the Authority of Dr *Hulſe*, that this is the Plant ſo much
" extolled by *Grey*: And in your *Synopſis*, you mention nothing of the
" Virtues of this Herb, and have referred the Praiſes which you be-
" ſtowed on it, to the *Coronopus*. I would know therefore, whether
" you have altered your Opinion, and whether you now think that
" Dr *Hulſe* was miſtaken about this Plant. For my own Part I am in
" great Doubt about it. *Grey* himſelf mentions no other Name, for
" the Plant which he ſo highly magnifies, but *Star of the Earth*; nor
" has he added any Deſcription, or characteriſtic Note, by which it
" may be known to others. I cannot imagine, how Dr *Hulſe* ſhould
" know with ſo much Certainty, that *Grey* meant the above-mentioned

" *Lychnis.*

" *Lychnis*. I very much queſtion whether that *Lychnis* is endowed " with ſuch Virtues, and earneſtly intreat you to remove my Scruples."

To this Inquiry that good communicative Gentleman condeſcended to return the following free and ingenuous Anſwer.

" As to your pertinent Queſtion concerning the Plant called *Star of* " *the Earth*, the Caſe ſtands thus: King *James* ſent to the *Royal Society* " a Sample of a Plant dried, which was ſent him for that which cured " his Dogs when bitten with a mad Dog, and by the Name of *the Star* " *of the Earth*. This Plant not being well dried and preſerved, none " of the *Royal Society* knew certainly what to make of; ſo they ſent it " to me, who, upon careful Examination of it, found it to be the " *Seſamoides Salamanticum Magnum*; whereupon Dr *Hulſe* ſending me " that Obſervation out of *Grey*, concerning the Uſe of the Plant called " *the Star of the Earth*, I thought I had Ground enough to attribute " the Virtue of curing the *Hydrophobia* to the *Seſamoides Salamanticum*, " not imagining that any would dare to abuſe a ſovereign Prince, by " ſending him a falſe Plant. But afterwards, conſidering that the *Co-* " *ronopus* was, for it's Reſemblance to a Star, called *the Star of the* " *Earth*, and that it was noted for ſuch a Virtue, but the *Seſamoides* " was neither like a Star, nor by any ſo called, nor deſcribed to have " ſuch a Quality; I concluded, that the Plant which *Grey* meant, was " the *Coronopus*, and not the *Seſamoides*, and that we had been abuſed " by a falſe Plant ſent to King *James*, for *the Star of the Earth*."

This Account from Mr *Ray* himſelf fully ſatisfied me, that the *Bucks-horn*, and not the *Catch-fly*, was the true *Star of the Earth*. But as to the curing of King *James*'s Hounds, I ſuſpect that Mr *Ray* was miſinformed as to that Matter, and am now almoſt perſuaded, that there was never ſuch a Thing; for I cannot but obſerve, that there is a moſt perplexing Inconſiſtency between the two Extracts which have been given from the Journal-Books of the *Royal Society*, relating to this Matter of Fact. The Words are theſe *:

" *Nov.* 16, 1671, Sir *R. Moray* exhibited a certain Plant, (which " by Mr *Ray* is called *Lichen cinereus terreſtris*) ſaid by Sir *R. M.* to " be very good to cure Dogs bitten by a mad Dog; his Royal High- " neſs having cauſed it to be given to a whole Kennel of Dogs bitten " by a mad one, which were all cured, except one of them, to whom " none of it was given. The Specimen was kept in the Repoſitory."

Query, Whether it be there ſtill?

" Afterwards, *viz. March* 1671-2, Sir *R. M.* mentioned, that a " whole Kennel of Dogs belonging to his Royal Highneſs, were bitten " by a mad Dog, and had been lately cured by an Herb called *Stellaria*, " or *Star of the Earth*. This Plant is the *Lych. viſc. flore muſcoſo, C. B.* " in *Engliſh*, *Spaniſh Catch-fly*: See theſe *Tranſactions*, N° 187, where " is a Receipt to cure mad Dogs, wherein this Plant is a principal

* See Vol. IX. Part iii. Chap. 5. §. xiii. 1.

" Ingredient, which Receipt, communicated by Sir *R. Gourdon*, was " there publiſhed by his Majeſty's ſpecial Command, *An.* 1687."

Now here are two very different Accounts from the ſame Perſon, relating to the ſame Thing. In the firſt, Sir *R. M.* ſpeaks of the Cure as performed by the *Lichen*; in the ſecond, in leſs than half a Year after the other, he mentions it as done by the *Stellaria*. Now it ſeems utterly improbable, that the Kennel of Hounds ſhould be twice bitten, and cured by a different Plant in ſo ſhort a Space: And indeed (as I hinted before) my preſent Opinion is, that the Hounds were never bit by a mad Dog at all, but that the whole Story has been founded upon an older one, of which there is Mention made in that Book written by *T. de Grey*, Eſq; called, *The Expert Farrier*, in the 2d Edition of which, in 4^to^, publiſhed in 1652, among other Cures for the Bite of a mad Dog, he preſcribes this which follows, *p.* 160.

" Take the Herb which groweth in dry and barren Hills, called *the* " *Star of the Earth*; you muſt give it three Days together. The firſt " Time you muſt gather three of theſe Herbs, with all the whole " Roots; and waſh them clean, and pound them well; which done, " give them to your Horſe in Milk, Beer, Ale, or White-wine, but " be careful the Horſe takes all the Herbs and Roots: If you will, " you may make up theſe Herbs and Roots in freſh or ſweet Butter, " which will do as well. The ſecond Day, give your Horſe five of " theſe Herbs and Roots, as before; and the third Day, give him " ſeven. Do this punctually, and you may be well aſſured your Horſe " will be perfectly cured; for albeit, I myſelf have never tried this " Medicine, yet I do know, the Party of whom I had this Cure, hath " cured much Cattle of all Sorts therewith. I myſelf can ſay thus " much of this Receipt, that I knew it cure a whole Kennel of Hounds " of a Gentleman's, one Beagle excepted, which they did not ſuſpect " to be bitten, which indeed was bitten; ſo he fell mad and died, but " all the reſt eſcaped. Another Time, a Gentleman's Son of my Ac- " quaintance was unfortunately bitten, who was cured by the Party who " taught me this Receipt; and this young Gentleman (who was then a " Boy of 10 Years old) was ſo far ſpent with the Rancor of the Diſ- " eaſe, before this Man took him in Hand, as that his Head began to " be addle, and he to talk very idly; yet he cured him, ſo as he lived " and did well, and is at this Hour living, and a very proper and hand- " ſome Man, *&c.*"

Thus far *de Grey*. Now, Sir, I am apt to think, that any one who conſiders what he ſays about the Kennel of Hounds, will be ready to conclude, that theſe were what Sir *R. M.* miſtook for the Duke of *York*'s Dogs, as ſeems plain from the remarkable Circumſtance of the one Beagle that had none of the Plant given him, mentioned in both the Stories. So ſtrangely may Errors ariſe, and be multiplied, by jumbling the Ideas of different Things together in the Minds and Memories of Men, how wiſe and learned ſoever. So far as I can find, all

the Concern King *James* had in this Affair, was his ſending a Plant to the *Royal Society*, which his Huntſman recommended as an excellent Remedy for the Bite of a mad Dog; and it ſeems to me very likely, that the Huntſman might have met with this Story in *Grey*, and told it to his Maſter, and this he might tell to Sir *R. M.* and it may be, the Man, to ſet out the Virtues of the Medicine the more, might tell the Duke, that ſeveral of his own Hounds were cured by it, whether it were really ſo or not. None of theſe Suppoſitions are impoſſible, nor, in my poor Judgment, very improbable.

To make this dark Affair appear in a ſtill clearer Light, let me deſire you to compare and conſider the following Extracts. In a Letter to Mr *Ray* from Mr *Aubry*, publiſhed by Mr *Derham*, and dated *Aug.* 5, 1691, there is this Paragraph, *p.* 250. "King *James* ſent by Sir —— "*Garden* (I ſuppoſe it ſhould have been *Gourdon*) to the *Royal Society*, "a Plant called *Star of the Earth*, with the Receipt made of it, to "cure the Bite of a mad Dog, which is in *Tranſactions*, N° 187." This refers to a Receipt communicated by Sir *R. Gourdon*, by his Majeſty's Command, and in which there is Mention of *the Star of the Earth*, and to which this *N. B.* is added, "The Plant in this Receipt, "and which is the chief Ingredient, is known among Botaniſts by the "Name of *Seſamoides Salamanticum* of *Parkinſon*, or *Lychnis viſcoſa*, "*&c.* of *Bauhine*, *Anglicè Spaniſh Catch-fly*. It grows plentifully about "*Thetford*, &c. *Vide Raii Cat. Pl. Angl. & Hiſt. Pl.* Tom. 2^do^, *inter* "*Lychnides*." This ſeems grounded upon what Mr *Ray* was afterwards perſuaded to be a Miſtake.

The next Thing I ſhall beg your Attention to, is a Letter from Sir *Hans Sloane*, to Mr *Ray*; prior indeed in Time to the former, being dated *June* 1, 1687, in theſe Words: "Sir, I ſend you incloſed the "Specimen of a Plant growing on *New-market Heath*, and in *Surrey*, "known by the Name of *the Star of the Earth* in thoſe Parts. It is "particularly taken Notice of on the Account of it's extraordinary and "admirable Virtue, in curing the biting of mad Dogs, either in Beaſts "or Men. One of his Majeſty's Huntſmen having proved it a great "many Times, gave the King his Way of uſing it, which was an "Infuſion in Wine with Treacle, and one or two more Simples. His "Majeſty was pleaſed to communicate it to *Greſham College*, to the "*Royal Society*; and no-body knowing the Plant by that Name, ſome "there preſent confirming it's Uſe in ſome Parts of *England* in that "Diſeaſe, the Herb being as little known here as if it came from the "*Indies*, I told the Society, I would let you have the beſt Specimen "of it, which I queſtion not is known to you. If you pleaſe to give your "Sentiments, you will extremely oblige, *&c.*" To this Mr *Ray* returned the following Anſwer: "Sir, I received your Letter with the "Specimen incloſed, which ſeems to me to be the *Seſamoides Salaman-* "*ticum Magnum* of *Cluſius*, or *Lychnis viſc. &c.* of *Bauhine*, which I "have obſerved to grow plentifully upon *New-market Heath*, *&c.* I "wonder

" wonder it ſhould have ſuch a Virtue as you mention, but it ſeems it " is well atteſted. Dr *Hulſe* writes to me, he finds it in *Grey*'s Farrier." This ſeems pretty evidently to refer to the ſame Plant mentioned by *Aubry*, and this ſurely was the Plant, that not being well dried and preſerved, the Society could not tell what to make of, and which Mr *Ray* found to be the *Seſamoides*, which he then thought was the Plant that *Grey* called *the Star of the Earth*; but upon further Conſideration, he was firmly perſuaded, that the *Coronopus*, and not the *Seſamoides*, was the Plant intended by *de Grey* (for ſo his Name ought to be written): And indeed, to me there ſeems to be the greateſt Probability, if not abſolute Certainty, of this latter Opinion; for the *Seſamoides* was a Plant ſo little known in *Grey*'s Time, that the Botaniſts who were contemporary with him, took it for a Plant that was wholly a Stranger in *England*, as may be ſeen in *Johnſon* upon *Gerard* and in *Parkinſon*, and the Manner of giving it, as directed by *Grey*, *viz.* firſt three, then five, and then ſeven Plants, Roots and all, ſpeaks it to be a ſmall Herb, ſuch as is the *Coronopus*, and not ſuch a large one, with a big, ſticky or woody Root, as the *Seſamoides*. This I am very ſure of, that in *Norfolk*, my native Country, (and which, if I miſtake not, was *Grey*'s alſo) the *Coronopus* is called *the Star of the Earth* (and among other Names given it by *Dodonæus*, this of *Stellaria*, and *Stella Terræ*, is one, *p.* 95, of the *Engliſh* Tranſlation; and he deſcribes it as lying ſpread upon the Ground like a Star; and *Gerard* gives the ſame Deſcription of it, and *Parkinſon*, in his *Theatrum*, yet more fully, *p.* 501, *viz.* that the Leaves lie round about the Root in Order one by another, thereby reſembling the Form of a Star, and therefore called *Herba Stella*; by which Name, among others, it is called by *Cæſalpinus*, *Lobel*, *&c.* But whoever met with the Name *Stellaria*, or *Stella Terræ*, among the *Synonyma* of the *Seſamoides* in any Botanick Writer before Mr *Ray*, who afterwards retracted it, as has been fully proved?) In that Part of *Norfolk* where I was born, not far from *Norwich*, towards the Sea-Coaſt, where the *Bucks-horn* Plantain grows abundantly, there was great Uſe made of it when I was but a Lad, and always with good Succeſs, ſo far as ever I could hear. One Story I can tell of my own Knowledge, which may ſeem too trifling to mention, were it not to ſhew the Efficacy of the Simple. About 40 Years ago, when I lived at a Place called *Debenham* in *Suffolk*, a Perſon unknown to me, having heard that I knew an Herb that was good againſt the Bite of a mad Dog, ſent to deſire a Sample of it, with Directions how to uſe it; and ſome Time after I had half a Dozen fine Chickens brought me. I aſked whence they came? It was anſwered from ſuch a one (the Name I have now forgot). I ſaid I did not know him: To which the Reply was, That it was the Man to whom I had ſent the *Plantain*, which had ſaved the Lives of half a dozen Hogs of his, that had been bitten by a mad Dog; and he thought the leaſt he could do, was to ſend me half a dozen Chickens as a Token of his Gratitude. After all, I will not be poſitive, that the

Lychnis,

Lychnis, or *Catch-fly*, is not good *contra morſum Canis rabidi*; but I am confident that it is not the true *Star of the Earth*.

You ſee I have taken a good deal of Pains to trace this Matter through all it's intricate Meanders. I have been forced, indeed, to deal pretty much in Gueſſes and Conjectures, which I am not very fond of; but as the Caſe ſtands, it could not well be avoided: And I ſhall be glad, if by this Means we may be got (as I hope we are) near the Truth, which is the Thing I aim at in this long Purſuit; and I have rode more than 50 Miles in this wet Winter Seaſon, (though *ferè Septuagenarius*) in order to diſentangle it from the Confuſion and Contradiction in which it has been involved. If any Doubt ſhould be made with reſpect to my Integrity, or Exactneſs in the Extract I have given you from Mr *Ray*'s Letter, the Original is ſtill in Being, and ſhall be produced, if deſired.

As for the *Liverwort*, I can ſay nothing from my own Knowledge; but by the Account of it's Virtues given by *Dampier*, (which he took for a Kind of *Jew's-Ear*, but which Sir *Hans Sloane* with great Reaſon affirmed to be the *Lichen cinereus terreſtris*) I cannot doubt but it is a potent Remedy, of which I preſume there may have been ſeveral ſucceſsful Experiments made, ſince thoſe made by *Dampier*'s Uncle, which are very conſiderable. And it may be King *James* might have ſome of his Hounds cured by this *Lichen*, after he came to the Crown, and might then ſend a Specimen thereof alſo to the Society.

P. S. A Friend of mine lately informed me, that there was a wonderful Cure performed upon a Woman in this Country, ſeveral Years ago, who had been bitten by a mad Dog, and in whom the evident Symptoms of the *Hydrophobia* appeared, who yet was ſaved, by God's Bleſſing, upon the Uſe of a Powder given by the Direction of the Lady *Brook* (a Perſon of Eminence formerly in *Suffolk*). It ſeems the Powder went by the Name of *The Lady* Brook's *Powder*, and was generally ſuppoſed to be chiefly, if not only, the *Coronopus* dried and pulverized: And I muſt own, that I have at preſent ſuch an Opinion of the great Virtue of this Simple, that till I have ſome convincing Evidence of it's having failed, I can ſcarce avoid looking upon it as a Specifick *contra morſum canis rabidi*; and I heartily wiſh, for the Sake of ſuch as ſhall at any Time happen to fall under ſo terrible a Misfortune, that it may be proved by Experience ſo to be.

Some Obſervations concerning the Virtue of the Gelly of black Currants, in curing Inflammations in the Throat. By Henry Baker,

XXI. From my Childhood, till within about 12 Years paſt, I uſed, almoſt conſtantly, upon taking Cold, to be ſeized immediately with an Inflammation in the Throat, attended with great Swelling, Throbbing, and Soreneſs: And notwithſtanding Bleeding and Purging, together with the Aſſiſtance of Gargles, Linctus's, and all the other Methods generally made uſe of in ſuch Caſes, it moſt commonly would take it's Courſe; that is, in about a Week or 10 Days Time, it would

F. R. S. No. 459. p. 655. Jan. &c. 1741.

would ſuppurate and break, a conſiderable Quantity of fetid Matter would be diſcharged, and then I ſoon recovered. During it's Continuance, I was unable to ſwallow any Thing but warm Liquids, and even thoſe not without much Difficulty and Pain; but upon it's breaking, I found immediate Eaſe.

This Diſorder attacking me 5 or 6 Times a Year, and ſometimes oftner, afforded but too frequent Opportunities of experiencing, that all the common Methods did me no Good at all; but, on the contrary, made my Uneaſineſs laſt the longer, by retarding the Suppuration: Which often determined me to leave it wholly to Nature, with the Aſſiſtance only of warm Broths and Gruels.

But, about 12 Years ago, I became acquainted with a learned and ingenious Clergyman, the Rev. Mr *Waſhbourne*, Vicar of *Edmonton*, and one of the Canons of *St Paul*'s; who told me, that from many Experiments on himſelf and others, ſcarce ever failing of Succeſs, he could almoſt aſſure me of a certain Cure, if, as ſoon as ever I ſhould perceive any Swelling or Soreneſs in the Throat begin, I would ſwallow, leiſurely, a ſmall Quantity of the Juice of *black Currants* * made into a Gelly; or, if the Gelly could not be got, a Decoction of the Leaves in Milk, or even of the Bark (if it ſhould happen in Winter) uſed by the Way of Gargle, would prove, he ſaid, a Specifick for all inflammatory Diſorders of the Throat.

Though I had no great Faith, I reſolved to try this eaſy Remedy: And, as ſoon as *black Currants* could be got, cauſed a Quantity of their Gelly to be made: Nor was an Occaſion of trying it long wanting, when, to my great Surprize and Joy, I found it's Effect beyond any Thing I could imagine; for in 2 or 3 Hours the Inflammation and Swelling entirely vaniſhed, and my Throat remained as eaſy as if nothing at all had happened.

From that Time till very lately, for a dozen Years together, this Medicine has never failed me once: But has, on numberleſs Trials, taken away this Diſorder from me in a few Hours. It has likewiſe had the ſame good Effect on many of my Friends, to whom I have at different Times recommended it, ſo that ſeveral of them are never now without it in their Houſes.

* *Ribes nigrum*, Raii *Hiſt. Plant.* Vol. II. *p.* 1486. Squinancy Berries: *Anginæ utiles* [*baccas*] *eſſe nomen Anglicum arguit.*

Dale *in* Pharmacologia *ſua in* 4*to*, *p.* 293, *(ait) Ribes nigra in angina commendatur.*

John Aubrey, Eſq; F. R. S. in his Miſcellanies, printed at *London*, 1721, in 8vo, *p.* 63, ſays, that a Gentlewoman had her ſore Throat cured by a Pulteſs of *blue Currants.*

The Efficacy of the Gelly of *black Currants*, in curing ſore Throats, has been long known among ſeveral good Women, who give away Medicines in the Country; yet it has been hitherto ſo overlooked by Phyſicians, as not to be ordered to be kept in the Apothecaries Shops; and even the *Rob* or Gelly of *Elder-berries*, which comes up to this next in Virtue, although ordered, is kept but in few Shops. *C. M.*

I have frequently preſcribed the Syrup or Gelly of black Currants, for Inflammations of the Throat, with good Succeſs. Moſt of the Apothecaries in *Chelſey* keep it in their Shops. *J. M.*

But

But a Diſappoinment I lately imagined I had met with from this Medicine, is the Reaſon of my laying before you the following Fact.

Upon taking Cold, about ten Weeks ago, I was ſeized with an Inflammation in my Throat, attended with Soreneſs, and throbbing Pain; on which I applied to my old Remedy, but without the uſual Succeſs; for though I took it ſeveral Times a Day, for 2 or 3 Days together, the Diſorder grew continually worſe, and the left Side of my Throat was ſo violently inflamed and painful, and ſwelled to ſuch a Degree, that I was not able to ſwallow even Liquids without Abundance of Trouble. In ſhort, it exactly reſembled the ſore Throats I uſed to be afflicted with before my Knowledge of this Medicine; and therefore I gave it up to take the ſame Courſe it was accuſtomed to do formerly.

After about a Week, when I had good Reaſon to believe there was a conſiderable Collection of Matter, and I expected it every Hour to break, I was called by Buſineſs to a Relation's Houſe at *Tottenham*, in *Middleſex*; where, being ſcarce able to get down a ſingle Diſh of Tea, my Friends (who have been long acquainted with the Virtues of *black Currant Gelly*) inquired wherefore I had not applied to my uſual Remedy: I told them that I had, but to no Purpoſe at all; which I knew not how to account for, unleſs, mine being above two Years old, Time had deſtroyed it's Virtue. They ſaid they had lately made ſome; and immediately fetched a Glaſs of it, which they perſuaded me to make uſe of.—I took 3 or 4 Spoonfuls of it, rather through Civility, than from any Hope of it's doing Good, at a Time when I every Moment expected and wiſhed it to break.

In about an Hour's Time, as I ſat by the Fire-Side, I perceived a Sort of diſagreeable putrid Smell, which I did not mind at firſt, ſuppoſing it ſomething accidental: But, finding a Continuance or rather an Increaſe of it, I began to examine what it might be owing to; and was convinced, after I had changed my Place, that it proceeded from myſelf, and was really the Smell of my own Perſpiration, which I found ſo much increaſed, as to become almoſt a Sweat. At the ſame Time, fancying my Throat a little eaſier, I took ſome more of the Gelly.

I came to *Tottenham* about 5 in the Afternoon, and began with the Gelly about 6. At Supper I with ſome Difficulty got down a little Gruel; and when I went to Bed, drank ſome Linſeed-Tea, ſweetened with Syrup of Mulberries. I ſoon got to ſleep; but, waking after ſome Hours, found myſelf in a gentle breathing Sweat, attended with the ſame unpleaſant putrid Smell. The Swelling in my Throat was, however, ſenſibly diminiſhed, and the Soreneſs much abated: At which being rejoiced, I took a Mouthful of the Gelly that ſtood by my Bedſide, and compoſed myſelf to ſleep again. A gentle Sweat continued during the whole Night; and, in the Morning, the Swelling, to my great Amazement, was quite reduced, and the Soreneſs ſo inconſiderable, that about 10 I eat ſome Toaſt with Chocolate, and by Dinner-

time

time had no more Remains of any Diſorder, than if it had never been.

I am very certain the Swelling was not diſcharged by breaking; for had it broke, even in my Sleep, I muſt have found ſome ill Taſte in my Mouth at waking: Whereas I was not ſenſible of any diſagreeable Taſte at all, but the Smell before-mentioned was greatly offenſive to me, whenever I put my Noſe into the Bed.

During the whole Time I have been ſpeaking of, that is, for about 17 Hours, I made Water but once only, and then in a ſmall Quantity: The Colour of it was very high, and it ſoon threw down an exceeding thick Sediment, as did all I made for 2 Days afterwards, though gradually clearing up more and more.

I ſhall not preſume to offer any Opinion as to the Manner this Medicine operates, but leave it to be conſidered by more proper Judges; only permit me to obſerve, that were the Virtues of Simples diligently inquired into, we might perhaps diſcover more ready and certain Cures for ſome Diſtempers than what we know at preſent. The barbarous *Negroes*, merely by Trials and Obſervations, have been able to find out both Poiſons and Counterpoiſons, on which (if our Accounts of them be true) they can depend with Certainty: And we know, that the Savages in *America* have diſcovered by the ſame Means, and generouſly taught us, the medicinal Effects of their *Ipecacuanha*, *Contrayerva*, *Peruvian Bark*, and ſome other Simples, which are almoſt infallible in curing the Diſorders of the Climate where they grow: Nor is it improbable, that every Country may produce Remedies for the Diſeaſes of it's Natives.

An Account of Symptoms ariſing from eating the Seeds of Henbane, with their Cure, &c. and ſome occaſional Remarks, by Sir Hans Sloane, *Bart. P. S. R.* No. 429. *p.* 99. July, *&c.* 1733.

XXII. In the Year 1729, a Perſon came to conſult me on an Accident that befel four of his Children, aged from 4 ½ to 13 ½ Years, upon eating ſome Seeds they had gathered in the Fields, near *Pancras* Church, which they miſtook for Philberts. He brought one of the *Capſules* with him: I inſtantly knew it to be that of the *Hyoſciamus niger*, *vel vulgaris*, C. B. (or the common Henbane) which bears ſome groſs Reſemblance to the Huſk of a Philbert; and the Seeds are like thoſe of the Poppy. The Symptoms that appeared in all the four were, great Thirſt, Swimmings of the Head, Dimneſs of Sight, Ravings, and profound Sleep; which laſt, in one of them, continued two Days and Nights.

I ordered them all to be bled, bliſtered in ſeveral Places, and afterwards purged with a Medicine compoſed of *Elect. lenitiv. Ol. amygd. dulc. flor. Sulph. & Syr. flor. Perſicor.* which operated both by Vomit and Stool: And by this Method they perfectly recovered.

The *Delirium* occaſioned by theſe Seeds differs from the common, and in ſome Meaſure agrees with that produced by the *Dutroa*, a Species of *Stramonium*; and by the *Bangue* of *Eaſt-India*, a Sort of Hemp: And they are all different from that Kind of Diſorder cauſed by the rubbing with a certain Ointment made uſe of by Witches (according to *Lacuna*, in his Verſion and Comments upon *Dioſcorides*) the Effect

of

of which (as he was told) is to throw the Perſons into deep Sleep, and make them dream ſo ſtrongly of being carried in the Air to diſtant Places, and there meeting with others of their diabolical Fraternity; that when they awake they actually believe, and have confeſſed, that they have performed ſuch extravagant Actions.

On this Occaſion I beg Leave to give an Inſtance of the great Virtues of Henbane-Seeds in the Tooth-ach. Some Years ago, a Perſon of Quality tormented with this racking Pain, had an Empyrick recommended to him; his Anguiſh obliging him to ſubmit to any Method of procuring Eaſe: The Quack conveyed the Smoke of burning Henbane-Seeds, by Means of a Funnel, into the hollow Tooth, and thereby removed the Pain: But at the ſame Time there dropped ſome Maggots from the Tooth (as he pretended) into a Pail of Water placed underneath for that Purpoſe; which was very ſurprizing to the Beholders. Being told the Story, I procured one of the Maggots, and ſent it wrapped up in Silk to Mr *Leeuwenhoek*, at *Delft* in *Holland*, where it arrived ſafe and alive. Upon Examination, he found it to be entirely like thoſe bred in ordinary rotten Cheeſe: Wherefore, he got ſome of theſe latter, and carefully fed them, and that I had ſent, on the ſame Cheeſe, and they were all, according to the uſual Methods of Nature, turned into ſmall *Scarabæi*; ſo that there appeared not the leaſt Difference between them either when Maggots or *Scarabæi*, both being returned me from *Holland*.

Upon the whole, though the Smoke of the Henbane-Seeds cured the Tooth-ach, it is highly probable the Maggots had been conveyed thither, and let drop into the Water by ſome Slight of Hand; ſeeing, by Means of ſome ſuch unjuſt Dexterity, Empyricks daily acquire Reputation from a Medicine, which from the Preſcription of an honeſt Phyſician would be taken little Notice of.

Concerning the Poiſon of Henbane Roots, by Dr Patouillat, *Phyſician at* Toucy *in* France. *Tranſlated from the* French *by* T. S. *M.D. F.R.S.* No. 451. *p.* 446. Dec. 1738. *Dated* February 9, 1737.

XXIII. The 26th of laſt Month, I was called to a Cottage very near *Toucy*; where I was ſurprized to find 9 Perſons together, all having the true Symptoms of being poiſoned; with this Difference, that ſome were ſpeechleſs, and ſhewed no other Signs of Life than by Convulſions, Contortions of their Limbs, and the *Riſus Sardonicus*; all having their Eyes ſtarting out of their Heads, and their Mouths drawn backwards on both Sides; others had all the Symptoms alike. However, 5 of them did now and then open their Mouths, but it was to utter Howlings: And whenever they expreſſed articulated Words, it ſeemed as if they would propheſy. One, for Example, ſaid, in a Month my Neighbour will loſe a Cow: Another, in a little Time you will ſee the Crown-Pieces of Sixty-pence at five Livres. [100 *d.*] Among theſe nine Perſons there was a Woman 5 Months gone with Child, a Child of 2 Years; four Boys of 9, 12, 15, and 18; and three Girls of 15, 17, and 19 Years of Age, who had all three the Misfortune of the Green-ſickneſs upon them at that Juncture of Time. The Madneſs of all theſe Patients was ſo complete, and their Agitations ſo violent, that in

order to give one of them the Antidote, I was forced to employ ſix ſtrong Men to hold him, while I was getting his Teeth aſunder, to pour down the Remedy: And as they could not all be watched at once, one of the Boys got away, and ran to a Pond 100 Paces from the Houſe, into which he leaped; but as he was ſeen, he was ſoon taken out.

It was vain to examine thoſe Wretches concerning the Nature of the Poiſon they had taken, as they were quite ſenſeleſs. Happily the Father of the Family, by being abſent, was free from this Misfortune. Of him I learned, that digging his Garden the preceding Day, he had found ſeveral Roots reſembling common *Parſnips*; and having carried them home for *Parſnips*, they were boiled in the Soop; and the unlucky Miſtake was not apprehended, till the Children were in this dreadful State. He deſcribed to me the Plant, which he thought he had taken for *Parſnips*; whereupon I went into the Garden, in order to find and know what it was; but as it had no Leaves, I was obliged to derive the Knowledge of it from the Roots; and ſoon knew it to be the *Henbane*, which is a very ſtrong Poiſon; and ſo much the more dangerous, as the Patients could give no Account of their Ailments, nor of the Quality of the Poiſon they had taken.

To the Boys I gave the *Tartar. Stibiat.* in ſo large a Doſe, that the oldeſt took 45 Grains, and the others in Proportion.

For the Woman, I had Recourſe to *Theriaca* in a triple Doſe; not thinking it ſafe to give her the Emetick, on account of her Pregnancy. I gave the ſame Remedy to the Child, by reaſon of it's Tenderneſs.

To the Girls, beſides the *Theriaca*, which they took in very large Doſes, (having made uſe of ℥iv of it) I gave warm Milk, wherein I diſſolved *Salt of Rue.* The next Day I viſited the Patients, and found them in a quite different Condition; for they had all recovered the Uſe of their Reaſon, but remembered nothing of what happened.

All this Day, every Object appeared double to them, that is, upon looking at a Man, a Beaſt, or a Tree, they ſaw two.

I returned to ſee them the next Day, and found that the Symptoms were removed; but were ſucceeded by another altogether as ſurprizing, to wit, all Objects appeared to them as red as Scarlet. This laſt Symptom ceaſed gradually on the third Day, and ſince that Time they have made no Complaint.

The Caſe of a Man who was poiſoned by eating Monks hood, or Napellus, *communicated to the* Royal Society *by Mr* Vincent Bacon, *Surgeon.*

XXIV. On *Monday* Night laſt, *Feb.* 5, 1732, about ten, I was called in Haſte to *John Crumpler*, a *Silk Weaver*, in *Spital-Fields*; when I came into the Room, I found him lying on the Bed, his Head ſupported by a By-ſtander, his Eyes and Teeth fixed, his Noſe pinched in, his Hands, Feet, and Forehead cold; and all covered with a cold Sweat, no Pulſe to be perceived, and his Breath ſo ſhort as ſcarce to be diſtinguiſhed: Enquiring into the Caſe, I was told that he had been very well all Day, and about 8 had eaten a very hearty Supper

of Pork, and a Sallad dreſſed with Oil and Vinegar; and though he was very merry at his Meal, he began immediately after to find an Indiſpoſition: I aſked of what the Sallad was compoſed? and was anſwered, that there were in it nothing but common Sallad Herbs, all which they bought at a Stall in the Market, except ſome Celery, which they had picked out of their own Garden. Suſpecting that he had been eating ſome poiſonous Herb, I aſked if he found in the Beginning of the Diſorder any Inclination to vomit? They ſaid, no; but that when he found his Illneſs come upon him with great Violence, he believed himſelf to be poiſoned, and forthwith drank a large Quantity of Oil, not leſs than a Pint in all, and after that he loaded his Stomach with Carduus-Tea till he vomited; and though he threw up the greateſt Part of his Supper, yet the Symptoms ſtill increaſed, which made them ſend for me; but before I could get to him, Things were come to the Extremity above-deſcribed. Having nothing at Hand but a Tea-ſpoonful or two of Spirit of *Hartſhorn*, I forced open his Teeth with the Handle of a Spoon, and as his Head was reclined, I poured the Spirit into his Mouth, which a little rouſed him, and firſt ſet him a coughing, and next a vomiting; I took the Advantage of the little Senſe that was returned, and continued plying him with Carduus-Tea until he had vomited ſeveral Times more, but I could not hinder his Swooning often between the Times of reaching, though I gave him after each 40 or 50 Drops of *Sal Volatile & Tinctur. Croc. aa. p. æ* (which I had ſent for) in a Glaſs of Wine; he at length began to find a Working downwards, as he afterwards expreſſed himſelf, which was followed by a Stool; after which he vomited 2 or 3 Times more, and then ſaid his Head was ſo heavy, and his Strength and Spirits ſo exhauſted, though his Stomach and Bowels were much eaſier, that he muſt needs lie down: His Pulſe was then a little returned, though very much interrupted and irregular, ſometimes beating two or three Strokes very quick together, and then making a Stop of as long, or a longer Time than the preceding Strokes altogether took up. Having obſerved that what he had laſt vomited was little more than the pure Carduus-Tea, I then gave him a Draught made of *Aq. Epidem. Ther. Androm. Conf. Alkermes*, &c. and gave Orders to make him ſome Sackwhey to drink between whiles, ſometimes alone, and in caſe of great Faintneſs with ſome of the above-named Drops. It being near one o'Clock, I left him, and calling to ſee him on *Tueſday* in the Forenoon, found him much amended: He had lain awake, though ſtill, an Hour or two after I left him, but being very cold and chilly, had a great deal of Covering laid on him, and then found a kindly Warmth come over his Limbs, which was ſucceeded by a moderate Sweat, and then a quiet Sleep of 4 or 5 Hours, from which he awaked very much refreſhed; and when I was there, was capable of anſwering the Queſtions I aſked him; I mean with regard to Strength; for his Senſes had never failed him but during the Swoonings. I wanted to ſee ſome of the Sallad, but was told that

F. R. S. No. 432. *p.* 287. April, &c. 1734.

they had eaten all that they picked, and the reſt was thrown upon the Fire, ſo that nothing could be ſeen but the Celery, which being the Produce of their own Garden, the Boy who gathered it the Evening before, was ordered to fetch ſome more of the ſame; he preſently brought a Specimen, which I took to be the common *Monks-hood* of our Gardens, called by *Moriſon* in his *Prælud. Botan. Aconitum Spicâ Florum pyramidali.* But that this Company may be more certain, I have brought a Specimen of the Plant taken from the ſame Place this Morning, which the Boy ſays is of the ſame Kind which he gathered before, and the Patient upon biting it, declares to have the ſame Taſte which he perceived on *Monday.* But it may be obſerved, that it was not then ſo much ſhot up into Leaves as it is now: I deſired him to give me an exact Account of what Alterations he found in himſelf after the eating it, and how they came on: He ſaid the firſt Symptom was a Senſation of a tingling Heat, which did not only affect his Tongue, but his Jaws, ſo that the Teeth ſeemed looſe; and his Cheeks were ſo much irritated, that the People about him, nay even his Looking-Glaſs could ſcarce perſuade him but that his Face was ſwelled to twice it's proper Size; this tingling Senſation ſpread itſelf farther and farther, until it had taken hold of his whole Body, eſpecially the Extremities; he had an Unſteadineſs in the Joints, eſpecially of the Knees and Ancles; with Twitchings upon the Tendons, ſo that he could ſcarce walk a-croſs the Room, and he thought that in all his Limbs he felt a ſenſible Stop or Interruption in the Circulation of his Blood, and that from the Wriſts to the Fingers Ends, and from the Ancles to the Toes, there was no Circulation at all; but he had no Sickneſs or Diſpoſition to vomit until he took the Oil, *&c.* Afterwards his Head grew giddy, and his Eyes miſty and wandring, next a Kind of humming or hiſſing Noiſe ſeemed continually to ſound in his Ears, which was followed by the Syncopes above recited.

There ſupped with him two Women the ſame Night; one of them happened to have a Diſlike to Celery, and therefore laid aſide all that ſhe took for ſuch; the other having before been out of Order, and was not then perfectly recovered, eat but ſparingly, but took this ſuppoſed Celery along with the other Herbs, and felt, and complained of all the ſame Symptoms, but in a leſs Degree than the Man had done. She would not be prevailed on to vomit, but only took the Cordial-Draught above deſcribed. I ſaw them both this Morning, the Man is quite well, but the Woman is ſtill out of Order.

They ſay that there was not put into the whole Sallad, more than what grows upon one of theſe Roots.

Concerning the Poiſon of Laurel-Water, by John Rutty, *M.D.* No. 452. *p.* 63. Jan. *&c.* 1739. *Dated* Dublin, May 17, 1732.

XXV. At *Liſminy* in *Weſtmeath*, a Girl of 18 Years old, very well and healthy, took a Quantity, leſs than two Spoonfuls, of the firſt Runnings of the *Simple Water of Laurel-Leaves*; whereupon within half a Minute ſhe fell down, was convulſed, foamed at the Mouth, and died in a ſhort Time; nor was there any Swelling on her Body.

XXVI. In

XXVI. In the Year 1727, a *Beech-Tree* was felled near *Elbing*, for the domeſtick Uſe of *John Maurice Mœller*, then Poſt-Maſter of *Elbing*, now Secretary of his native City. The Trunk being ſawed into Pieces, one of theſe, three *Dantzick* Feet ſix Inches long, cleft in the Houſe on the 30th of *June*, diſcovered ſeveral Letters in the Wood about one Inch and a half from the Bark, and near the ſame Diſtance from the Centre of the Trunk. The Hewer having at one Stroke unfolded ſuch a Prodigy, and believing there was Witchcraft at the Bottom of it, ran in all poſſible Haſte for his Maſter: But this Gentleman, well inſtructed in ſound Philoſophy, gave Orders to preſerve the Pieces of Wood, and had them brought to my Study, at the ſame Time communicating to me the Hiſtory, and his Sentiments thereon.

An Account of Letters found in the Middle of a Beech, by J. Theod. Klein, *Secretary of* Dantzick, *F R. S. Tranſlated from the* Latin *by* T. S. *M D.* No. 454. *p.* 231 July, *&c.* 1739.

Fig. 85 exhibits the Letters conſpicuous in the ſolid Wood, two of which, D B, ſhew their old Bark ſmooth and ſound. The Wood lying between the Letters and the Bark of the Trunk, as well as that between the Letters and the Heart of the Tree, is likewiſe ſolid and ſound, bearing not the leaſt Trace of Letters. The Characters B D, being ſomewhat hollow, receive the Bark of the Letters D B *. Fig. 85.

The ſame Letters are ſeen in the Bark of the Tree, only that they are partly ill-ſhaped, partly almoſt effaced, whereas thoſe within bear a due Proportion, as if done with a Pencil.

Now ſhould it be aſked after what Manner theſe Letters reached the Middle of the *Beech?* and how it came to paſs, that two of them, and no more, had their old dry Bark ſticking to them?

Both theſe Queries are anſwered by the Vegetation of Plants. But as this is not a proper Place to expound it, I will ſuppoſe it known, and thus briefly complete the Affair.

It is an ancient Cuſtom to cut Names, and various Characters, on the Rinds of Trees, eſpecially on ſuch as are ſmooth. That this has happened to our *Beech*, the mere Inſpection of the Bark commands our Affirmation †.

An Inciſion made, the *Tubuli* conveying the nutritious Juice, and the *Utriculi*, in which it is prepared, are divided and lacerated, and more of them, as the Inciſion was made deeper and wider; and conſequently the Sap is not carried on in the Circulation, but extravaſated and ſtopped at the Wounds. Hence the Origin of the Characters in the Bark and Wood.

Now as a new Circle of *Fibres* grows yearly on the Tree between the Wood and Bark, it is not impoſſible but a Number of theſe ſhould, in a Proceſs of Years, more and more ſurround the ingraved Characters, and at length cover them. And this Number was the greater in our *Beech*, on account of better than half a Century elapſed ſince the In-

* *Daniel Barckholtz*, formerly *Cæſarean* Poet-Laureat.

† The Characters, beſides D B, mark the Names of a noble Family, to which the Land, whereon the Tree was felled, formerly belonged: *Reginæ, Dorothea, Michael, Gertrude, Joannes, Helwingii.*

ciſion,

ciſion, which was made in the Year 1672, as appears on the Outſide of the Bark, as may be ſeen in the Figure. But while new Circles of *Fibres* are ſucceſſively added, the *Tunicle* or Skin of the Bark is broken each Time, and the *Utriculi* extended and dilated.

Wherefore it is eaſy, from what had been ſaid, to draw the Reaſon, why the Bits of Bark cut off on all Sides, in the Letters D B, had the ſame Fate with the Letters; why the Wood between the Bark and Letters was ſolid and ſound; and why the Shapes of the Letters bore a juſt Proportion in the Middle of the Wood, and not in the Bark.

So much for our *Beech*.

Now let us ſee, in few Words, what Authors ſay of ſuch figured Woods.

Solomon Reiſelius, of *Letters found within the very cleft Trunk of a* Beech, *Eph. Nat. Cur. Dec.* 1. *An.* 6. *Obſ.* 4. has at length, though with ſome Difficulty, gueſſed the genuine Cauſe from frequent Examples of Inciſions.

But *Joannes Meyerus, on a Thief hanging from a Gibbet, drawn by Nature's Pencil in a* Beech, *Eph. N. C. Dec.* 3. *An.* 5. *Obſ.* 29. and *Joannes Petrus Albrechtus, on a certain rare Figure ſeen in a* Beech, *Eph. ibid.* aſcribe it to a Sport of Nature, and give this Reaſon; becauſe they could not diſcover the leaſt Sign of Impoſture, the deep Situation of the Figures hindering them from having any Suſpicion on that Head.

On the contrary, *Luke Schræckius, on figured* Beech-Wood, *Eph. N. C. Dec.* 3. *An.* 7, 8. *Obſ.* 118. follows *Reiſelius*'s Opinion; and being verſed in *Malpighi*'s Anatomy of Plants, writes: "No Wonder, "if Figures cut in a young Tree, by the Length of Time, and the "Accretion of many Barks, appear at laſt about it's Middle, when "grown old."

John Chriſtopher Gottwald, on a crucified Man drawn by Nature in the Middle of a Beech-Trunk *, *Eph. N. C. Dec.* 3. *An.* 9. *Obſ.* 158. accuſing Nature's ſimple Violence, or a Diſeaſe of the Tree, is corrected by the moſt celebrated *John James Scheuchzer*, in his *Itinera Alpina, Tom.* 3. *p.* 414. and in *Herbarium Diluvianum, p.* 46. *of a little Man in* Beech-Wood, *Tab.* X. where he makes mention of other Inſtances.

John Melch. Verdries is of the ſame Sentiment, treating *of a Figure found in the Middle of a* Beech, *Eph. N. C. Cent.* 3 & 4. *Obſ.* 89.

There remains, to my Knowledge, *the Figure of a Chalice, with a Sword perpendicularly erect, and on it's Point ſuſtaining a Crown*, found in the Heart of a Piece of Wood at the *Hague*; which the Authors of the Collections of *Breſlau* exhibit to us "as a ſingular *Phænomenon*, "worthy of being compared to *Aldrovandus*'s *Guaiacum-Tree*, and "figured Stones, if no optick Fallacy, Error of Judgment, artificial "Fiſſure of the Wood, or other ſuch Deceit, intervene,"

* This Wood is kept in the Library of the Council of *Dantzick*.

Fig. 83.

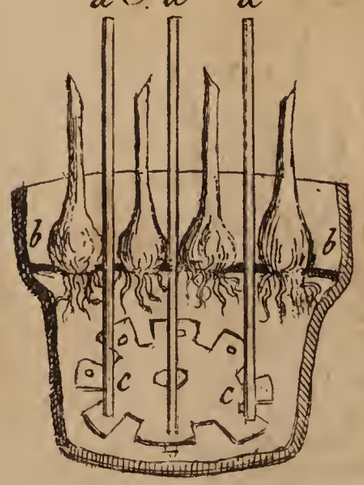


Fig. 84.

Fig. 85.

XXVII. 1. The Horn of a large Deer was found in the Heart of an Oak in *Whinfield-Park* in *Cumberland*, belonging to the Earl of *Thanet*. It was discovered upon cutting down the Tree. It was found fixed in the Timber with large Iron Cramps; it seems therefore, that it had at first been fastened on the Outside of the Tree, which in growing afterwards had inclosed the Horn. In the same Park I saw a Tree 13 Feet of Diameter.

F. R. S. Dated Nov. 6, 1731.

Of the Horn a Deer found in the Heart of an Oak, by Sir John Clerk, *one of the Barons of the Exchequer in* Scotland, *and* Ibid. *p.* 235.

2. This Horn of a Deer found in the Heart of an Oak, and that fastened with Iron Cramps, is one of the most remarkable Instances of this Kind, it being the largest extraneous Body we have any where recorded to have been thus buried, as it were, in the Wood of a Tree. If *Joannes Meyerus*, and *Joannes Petrus Albrechtus*, (p. 233.) had seen this, they could not have imagined the Figures seen by them in Beech-Trees to have been the Sport of Nature, but must have confessed them to have been the Sport of an idle Hand. To the same Cause are to be ascribed those Figures of *Crucifix*'s, *Virgin Mary*'s, *&c.* found in the Heart of Trees; as, for Example, the Figure of a *Crucifix*, which I myself saw at *Maestricht*, in the Church of the *White Nuns* of the Order of St *Augustin*, said to be found in the Heart of a Walnut-Tree upon it's being split with Lightning. And it being usual in some Countries to nail small Images of *our Saviour* on the Cross, of *Virgin Mary*'s, *&c.* to Trees by the Road-side, in Forests and on Commons, it would be no greater Miracle to find any of these buried in the Wood of the Tree, than it was to find the Deer's Horn so lodged.

Remarks by the Publisher. Ibid. *p.* 236.

Sir *Hans Sloane*, in his noble *Museum*, hath a Log of Wood brought by Mr *Cunningham* from an Island in the *East-Indies*, which, upon being split, exhibited these Words in *Portuguese*, DA BOA ORA. i. e. Det [*Deus*] bonam Horam.

End of the Eighth VOLUME.